From:	SEEDS Joshua <SEEDS.Joshua@deq.state.or.us>
Sent time:	01/31/2014 03:27:24 PM
To:	jeffrey.lockwood@noaa.gov
Cc:	Powers, David
Subject:	Species Distribution and Critical Habitat
Attachments:	Jan 31 2014_Model Presentation for RipStream.pptx

Hi Jeff. I hope everything is going well. The rulemaking for small and medium fish-bearing streams continues apace. We saw results today suggesting that an 80ft no-cut may be necessary to meet the Protecting Cold Water criterion of the temperature standard. I've attached the presentation; please keep in mind that the analysis is ongoing so this should be considered draft. Predictably, the industry is calling into question the validity of the standard, despite the fact that the Technical Advisory Committee validated it. But that's not why I am writing.

The PCW applies where T&E species are present *or* critical habitat is present *or* where preventing a temperature increase is necessary to meet applicable temperature criteria downstream, such as PCW in downstream critical habitat or the numeric criteria where water temperature is near the threshold. Can you point me to NOAA's maps of species distribution and designated critical habitat and the descriptions of the critical habitat? If I can get the shapefiles for the species distribution and critical habitat, that would be good, too. It's very important that we nail down exactly where PCW applies. Part of that is determining whether part of all of the fish-bearing network is considered critical habitat.

Thanks,
Josh

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RipStream Riparian Rule Analysis Analysis Tool Development & Preliminary Findings

RipStream External Review Committee

31 January 2014

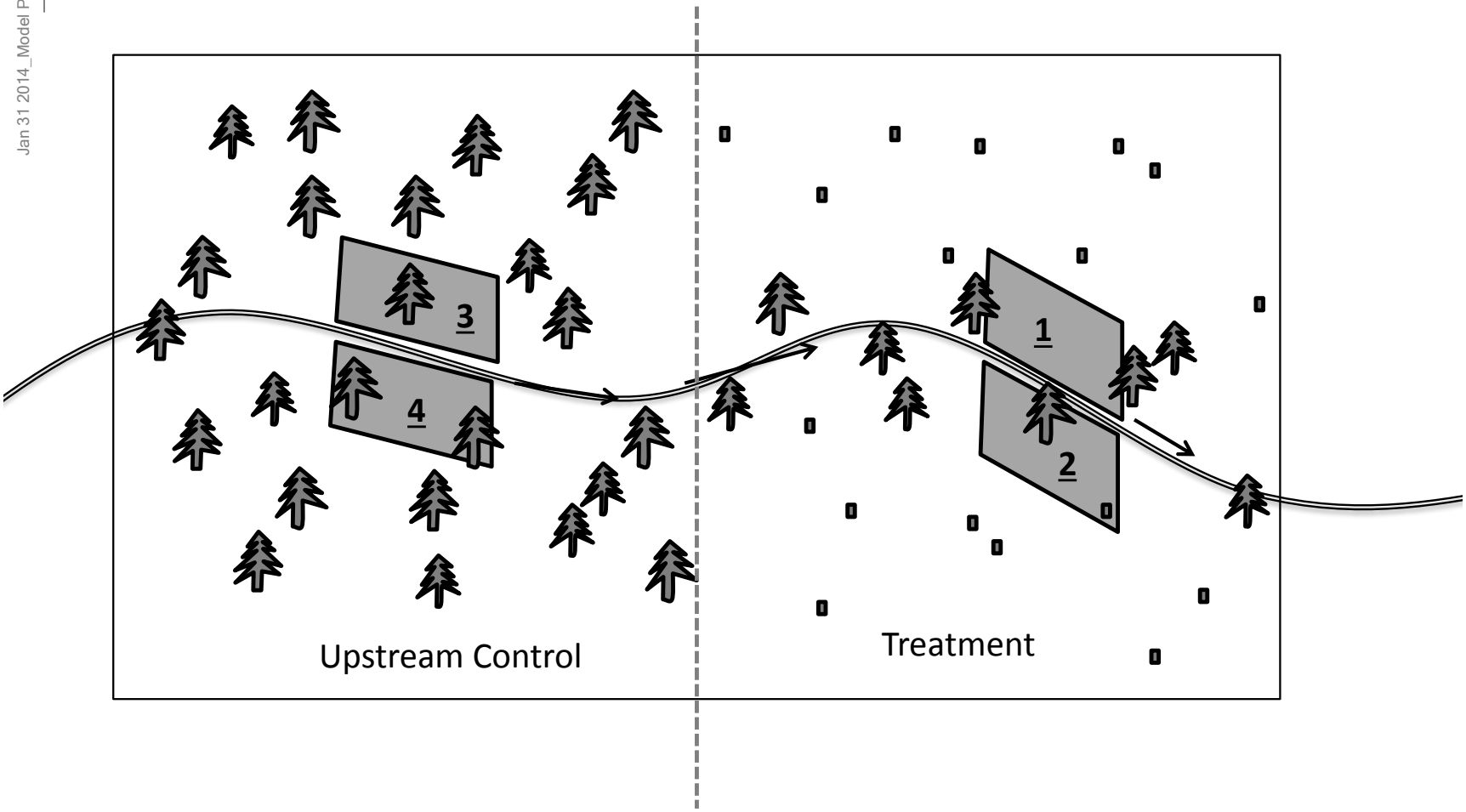
Outline

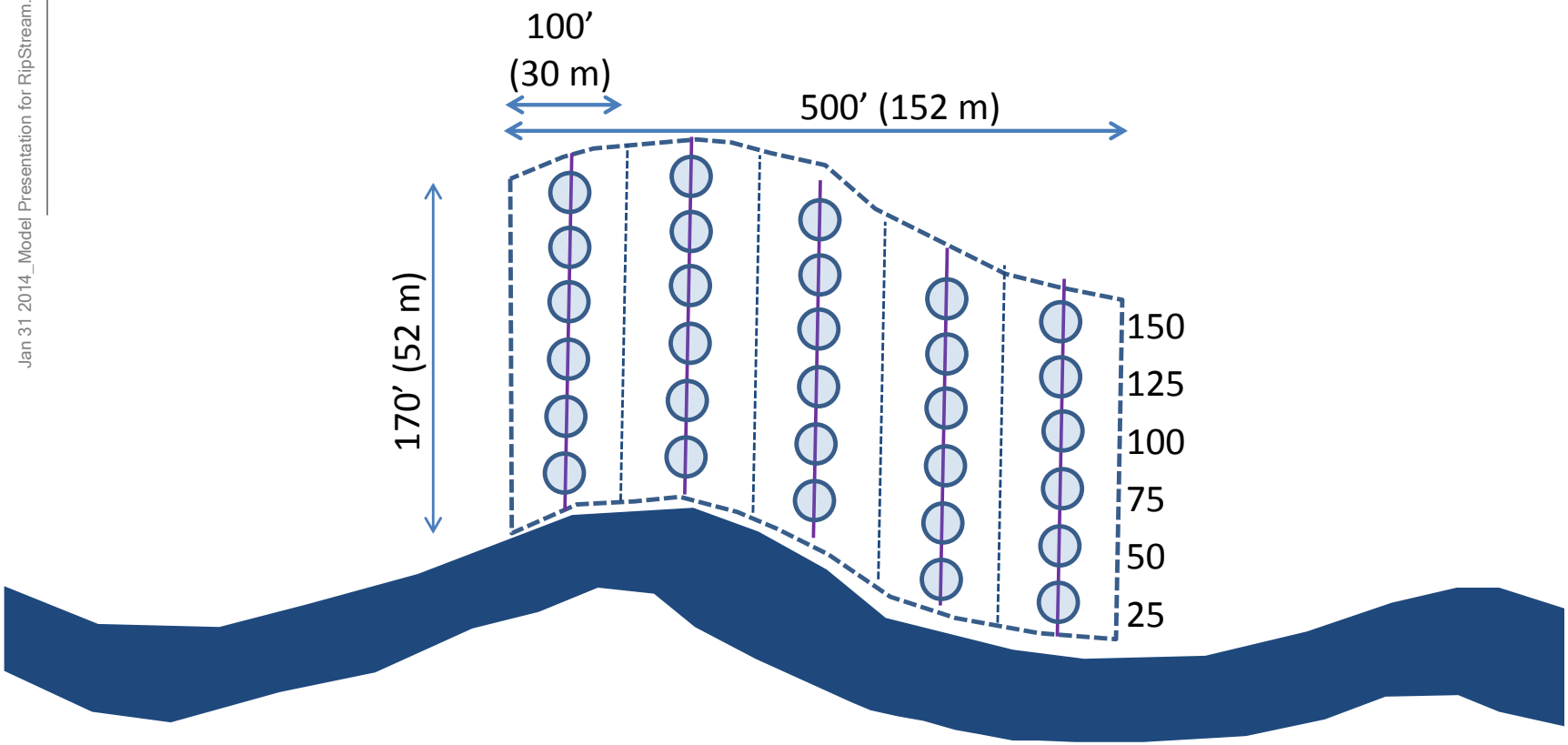
- Meeting goals
- Vegetation plots and what they tell us
- How we are using vegetation plot data
- Analysis
  - Background: what we're doing
  - How it works
  - Shade model alternatives & results
- Prediction Results:
  - As harvested
  - State Forests
  - FPA
  - By distance
  - By % basal area

Goals

- Common understanding of model:
  - How it works
  - What goes into it
  - How it can be used
  - Role of the vegetation plot data
- Input on the model process
- Input on prescription development

PLOT LAYOUT



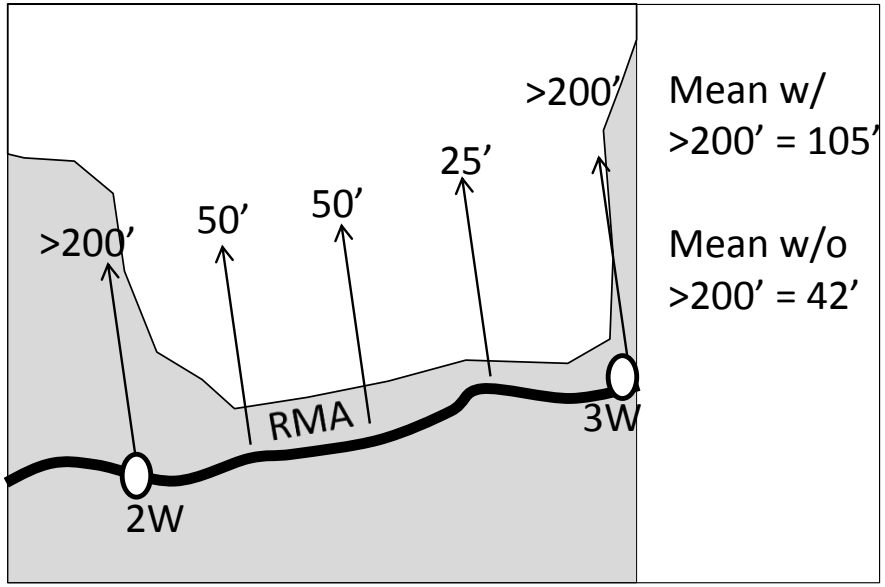

100’
(30 m)
500’ (152 m)
170’ (52 m)
150
125
100
75
50
25

Information from veg plots

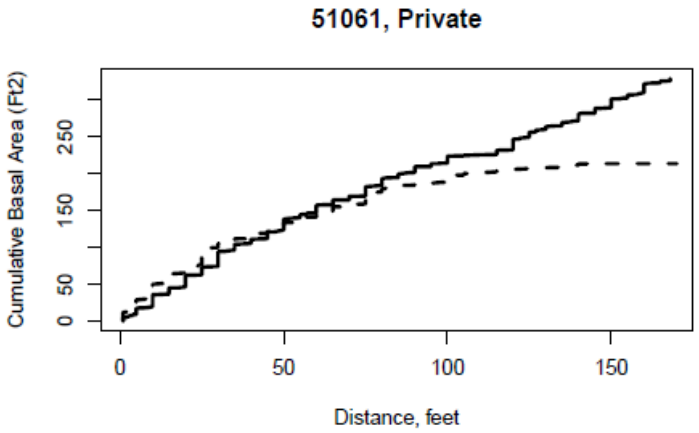
- BA pre, post, change
- Species composition
- Tree height pre (not post)
- Snag/live
- Line that trees were harvested along
- Tree distance (horizontal, slope)
- Distance from stream to “harvest”

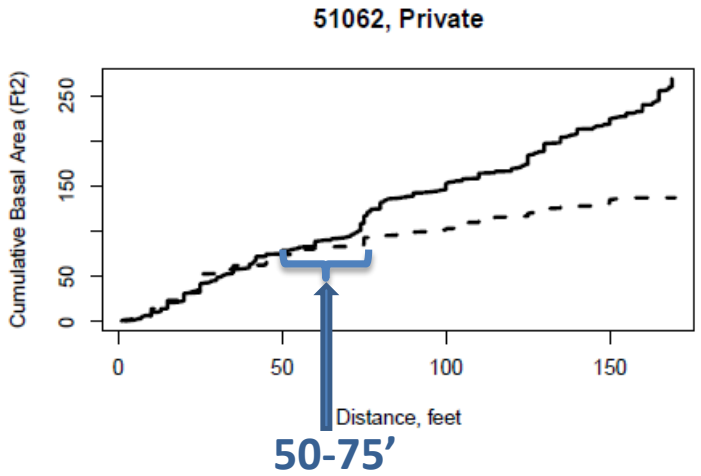
Distance

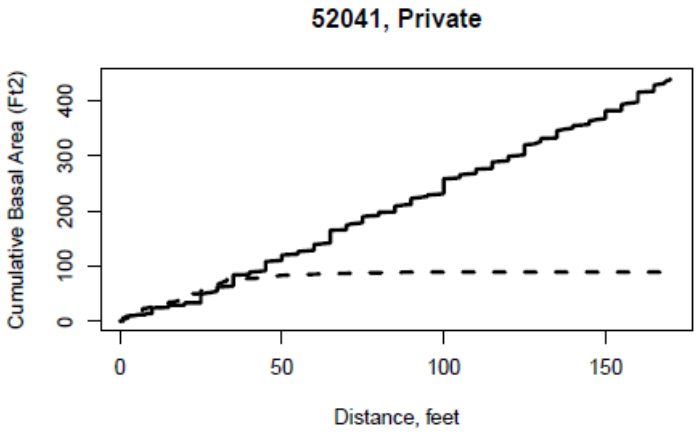
- FEM paper: used intern-measured buffer widths

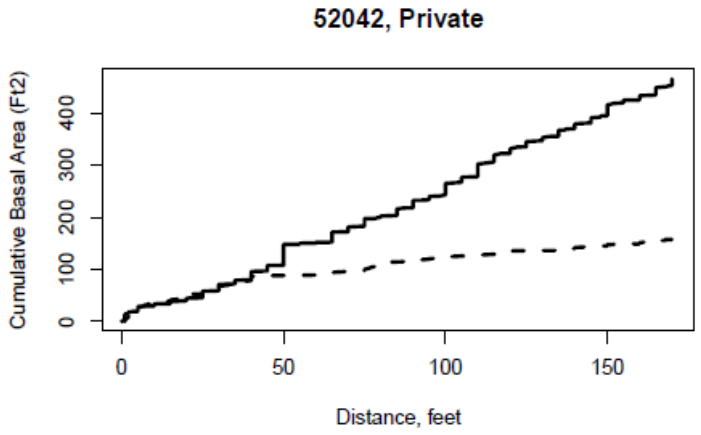


Distance – Vegetation Plots (visual)

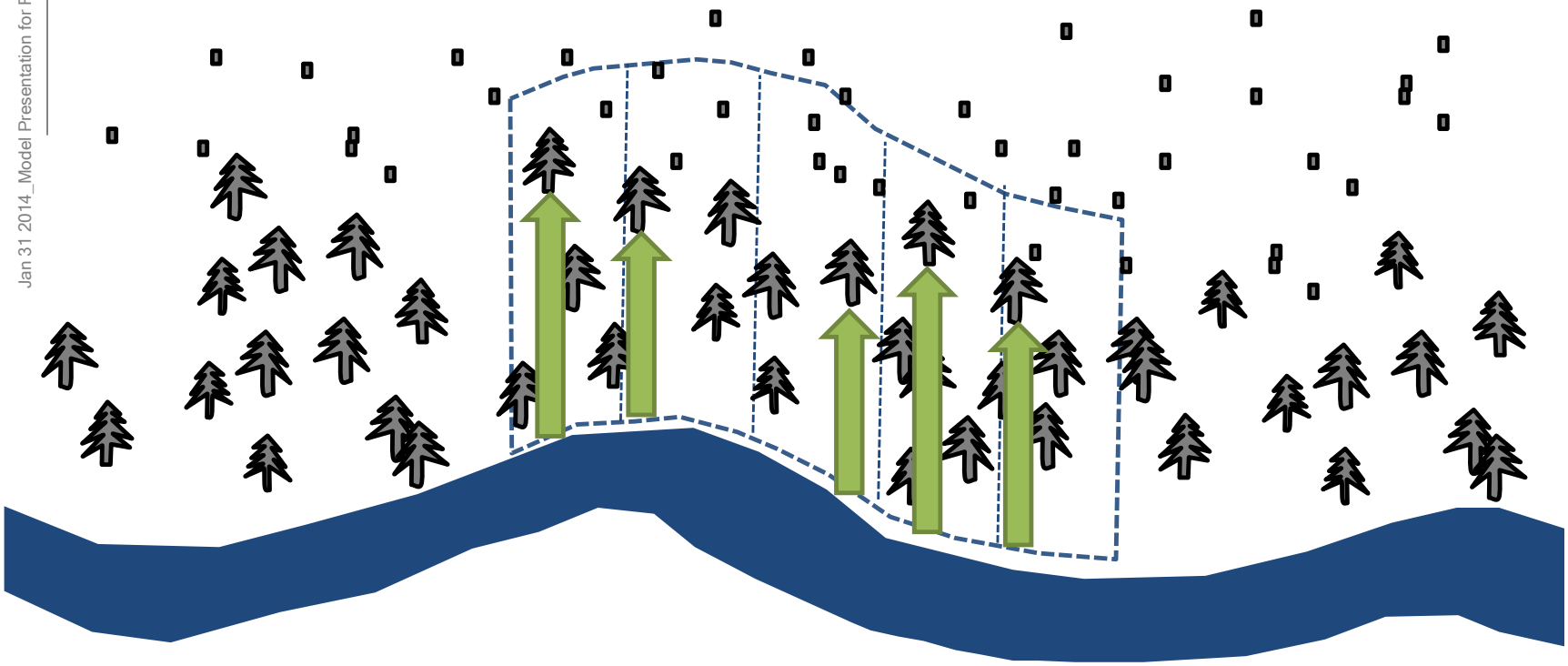








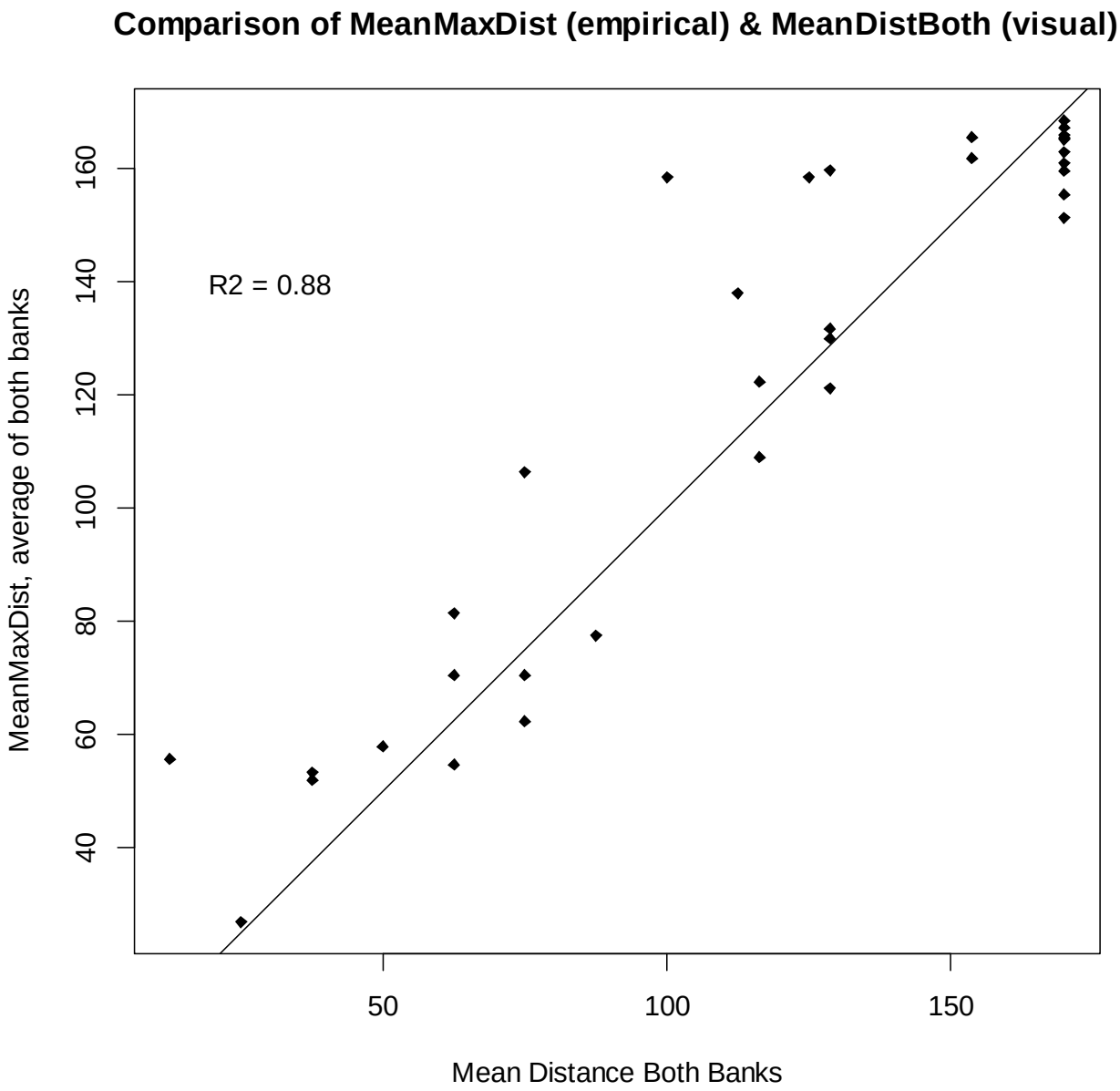
Distance: Vegetation Plot (Empirical)



DISTANCE
Which tree in each line is the farthest from the stream?

Of the 5 maximum line distances…

Minimum? MinMaxDist
Mean? MeanMaxDist
Max? MaxMaxDist


Comparison of MeanMaxDist (empirical) & MeanDistBoth (visual)
R2 = 0.88
MeanMaxDist, average of both banks
40
60
80
100
120
140
160
50
100
150
Mean Distance Both Banks

On to the Analysis…

Analysis path concept

Effects analysis

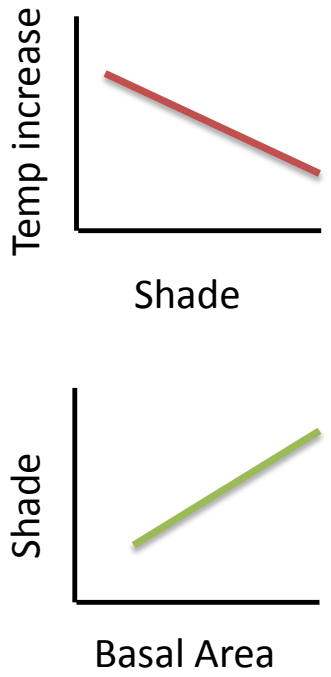
Prediction tool

Vegetation plot preparation

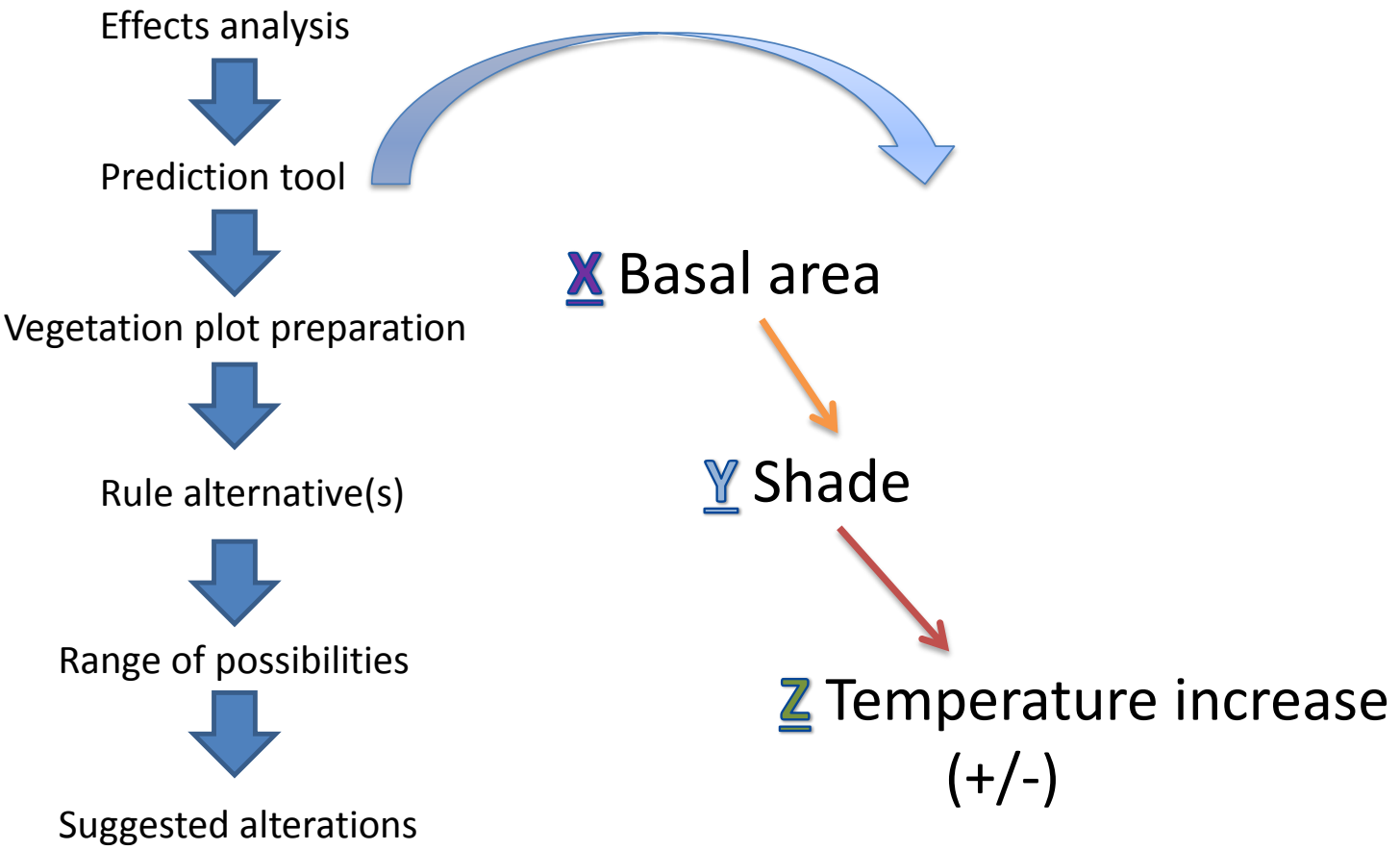
Rule alternative(s)

Range of possibilities

Suggested alterations



Analysis path concept



Analysis path concept

Effects analysis

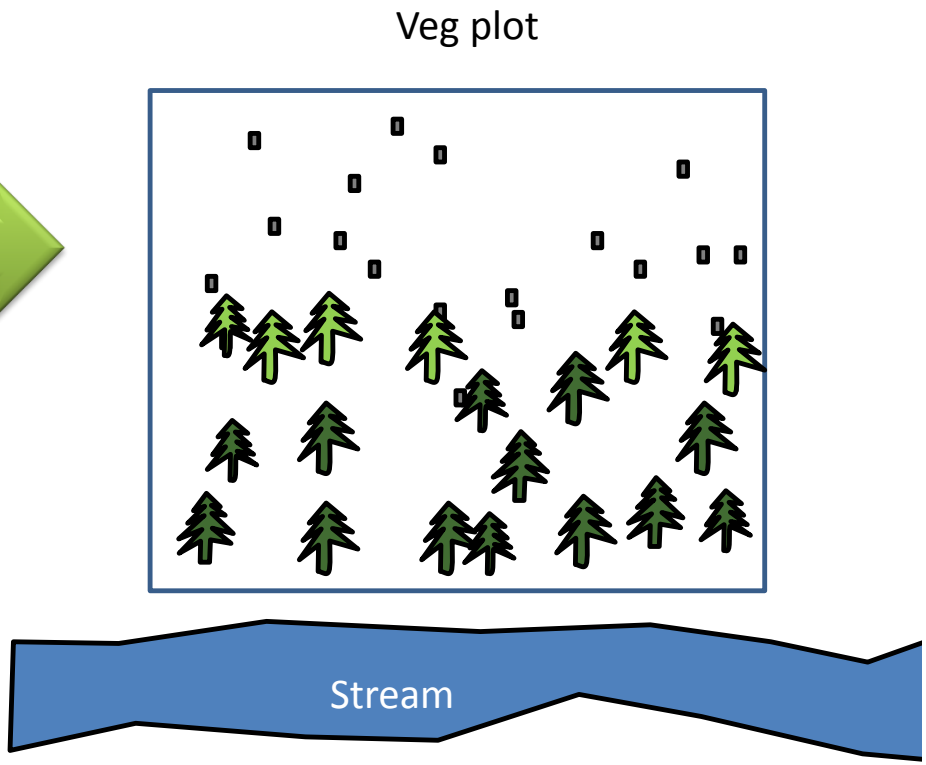
Prediction tool

Vegetation plot preparation

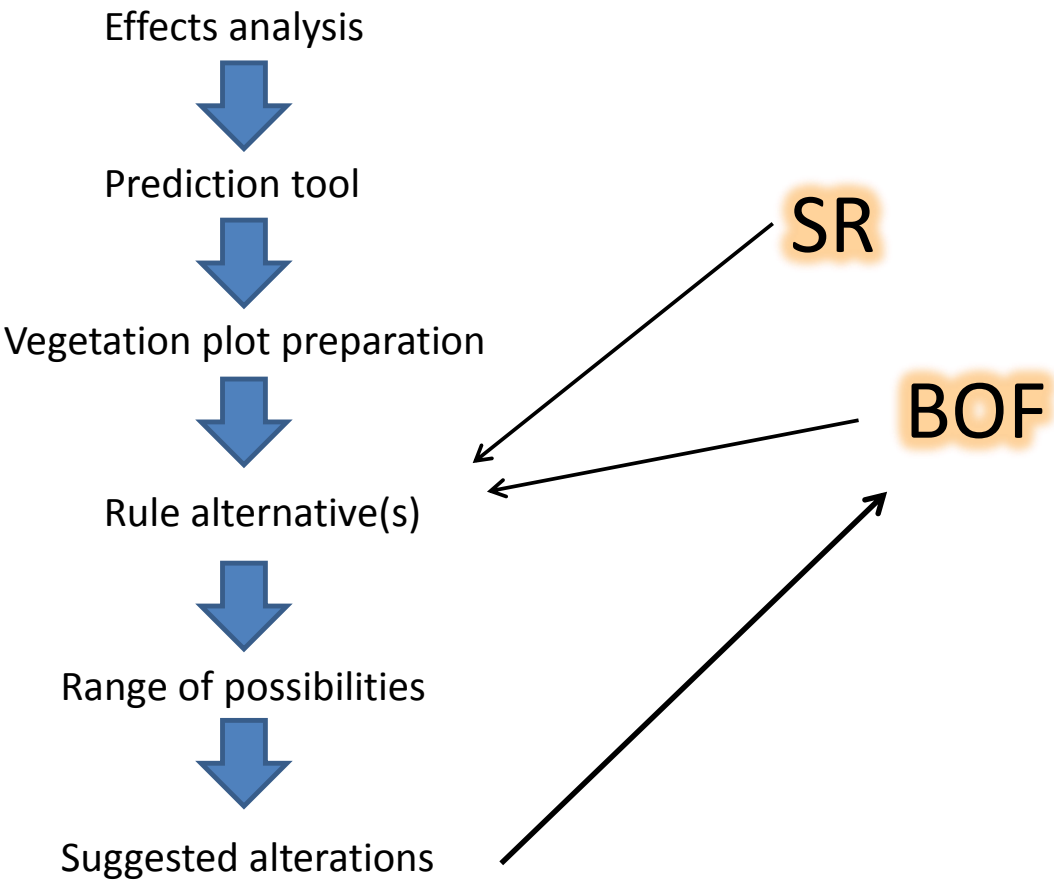
Rule alternative(s)

Range of possibilities

Suggested alterations

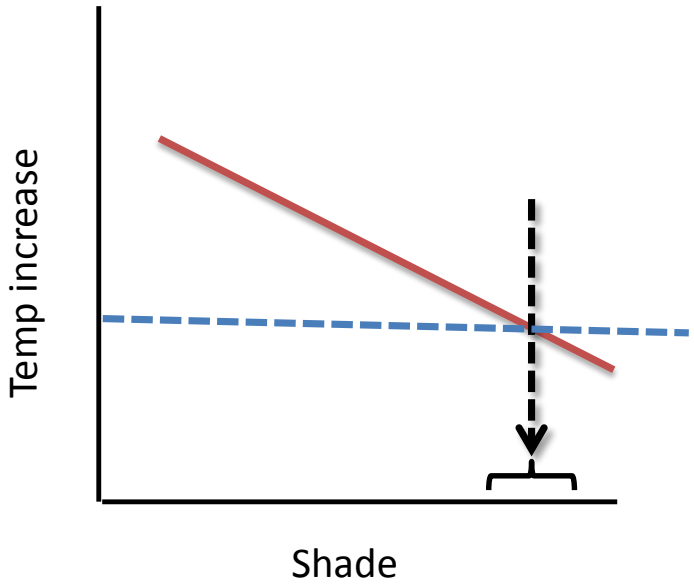


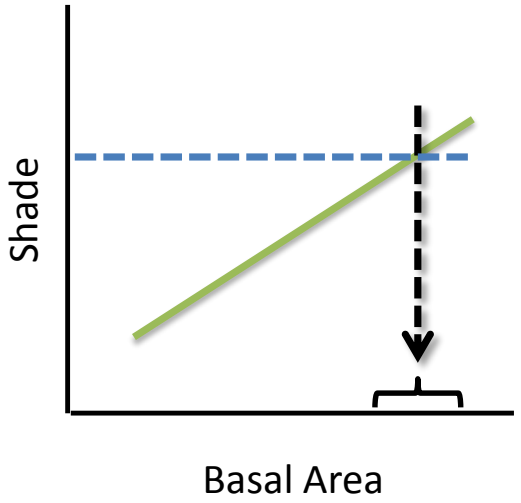
Analysis path concept



Prediction Tool

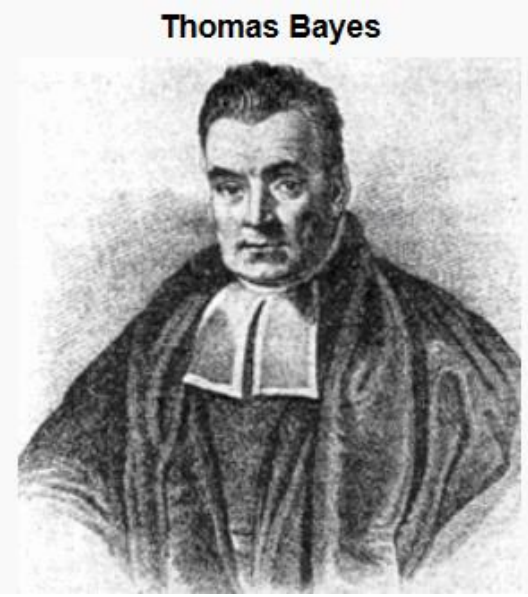
Temperature ⟷ Shade ⟷ Basal Area





Linking analyses

How can we effectively “tie” analyses together?



Bayesian Analysis

- Bayesian & Frequentist
  - Frequentist: Data are random (random draws)
    - » Variables = fixed
  - Bayesian: Variables are random
    - » Data = fixed

- Key point: Models are the same.
  - Probabilities = different

Bayesian Analysis

- Why?? What does this give us?
  - Be able to say “80% chance that temperature increase will be less than 0.2 ˚C”
  - Single model, more information
    - Integrates many data sources easily, defensibly
  - Missing data estimated
  - Many assumptions, but true of MLE models too
    - Restrictions not as limiting

Making the jump

- Using same/similar models as before
  - Shade = weighted regression, Temp = mixed effects
- Coolness:
  - Two sites = missing pre-harvest temperature data, so analysis imputes values
  - With a Bayesian analysis, easy to estimate ***whatever***
- Get ready for equations

Stream Temperature Change

- Temperature: for year i, measuring temperature change in j site…

Mixed Effects

$$\Delta T_{3-2ij} = \alpha_0 + \alpha_j + (\beta_1 \Delta TControl_{2-1} + \beta_i \Delta TControl_{2-1j}) + \beta_2 TreatmentReachLength + \beta_3 Shade + \beta_4 GradientQuartile$$

Detour: shade model development

The ideal shade model

For RipStream, the ideal shade model…

- Explains shade results well
- Makes sense
- Includes all data out to 170’
- Includes a measure of harvest distance

Published model
Forest Ecology & Mgt 2011

Logit of shade = Basal area post-harvest + tree height

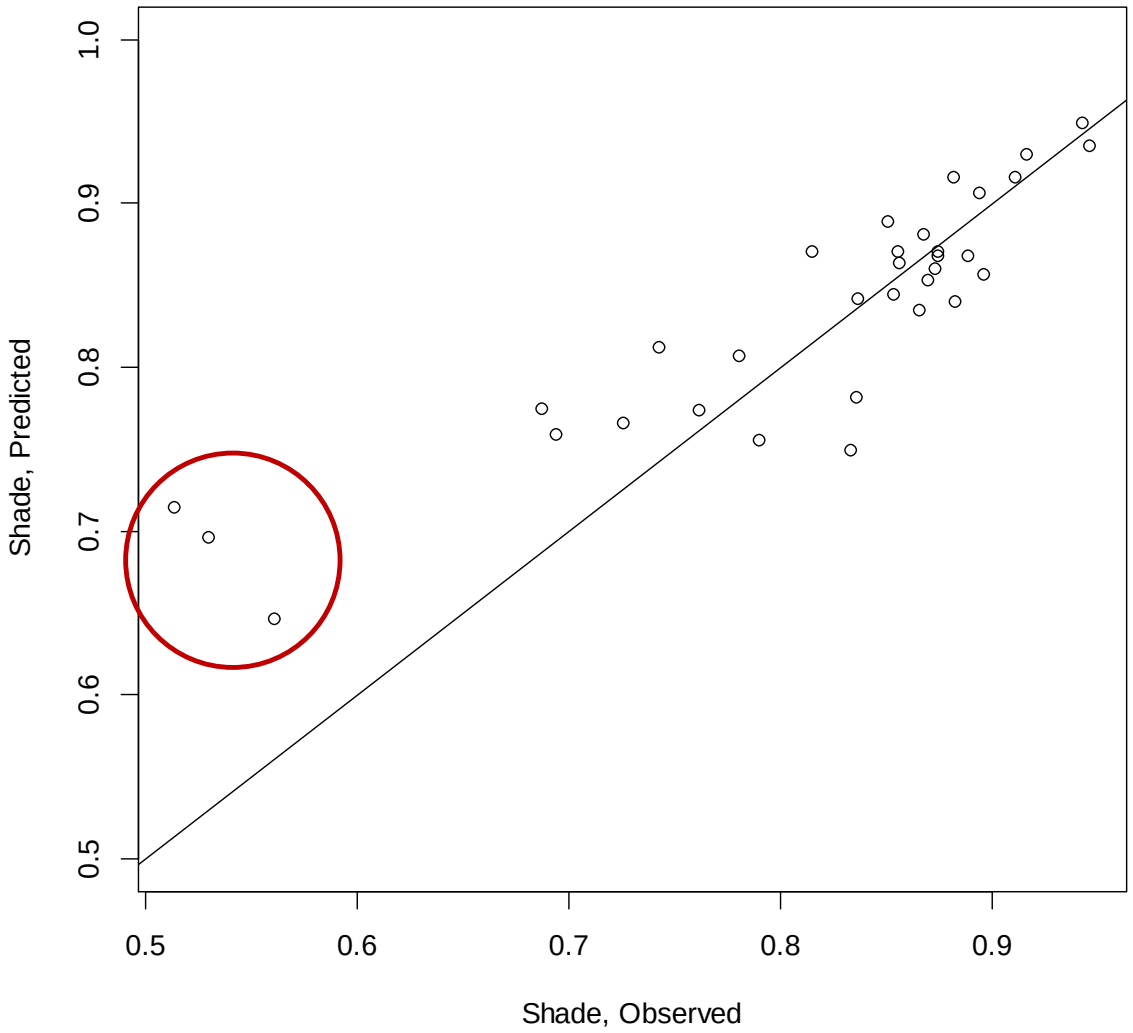
Model does well (explains ~ 70% variation)

Examines forest out to 100’

Revised shade model: Shade 1

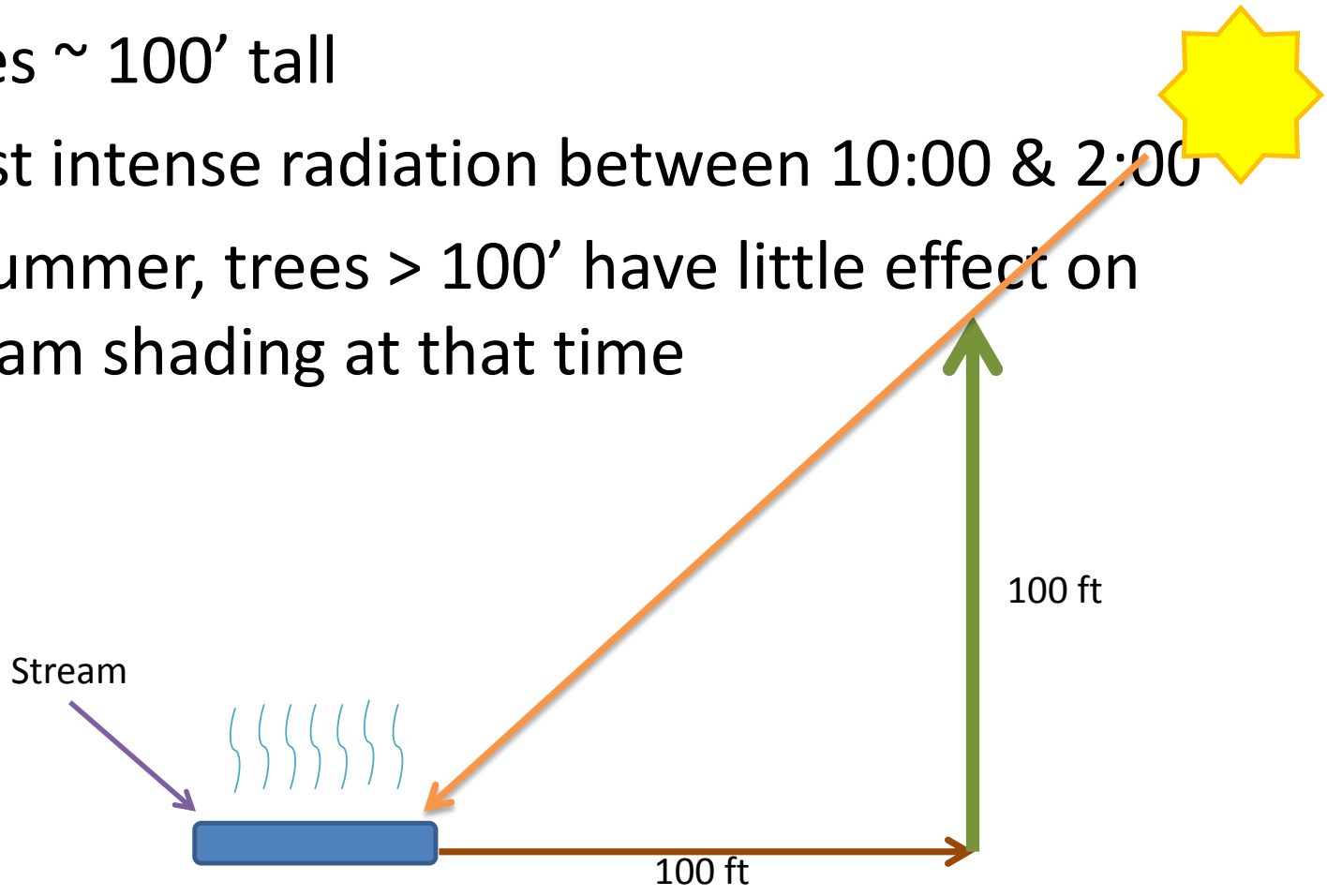
$$Shade_{Post} = \alpha_{Shade} + \beta_{1Shade} Basal\ AreaPre + \beta_{2Shade} TreeHeight + \beta_{3Shade} Basal\ AreaPre * TreeHeight + \beta_{4Shade} BA\_Reduction + \beta_{5Shade} PctHardwoodPre$$

Shade 1: Observed data vs. Predicted data



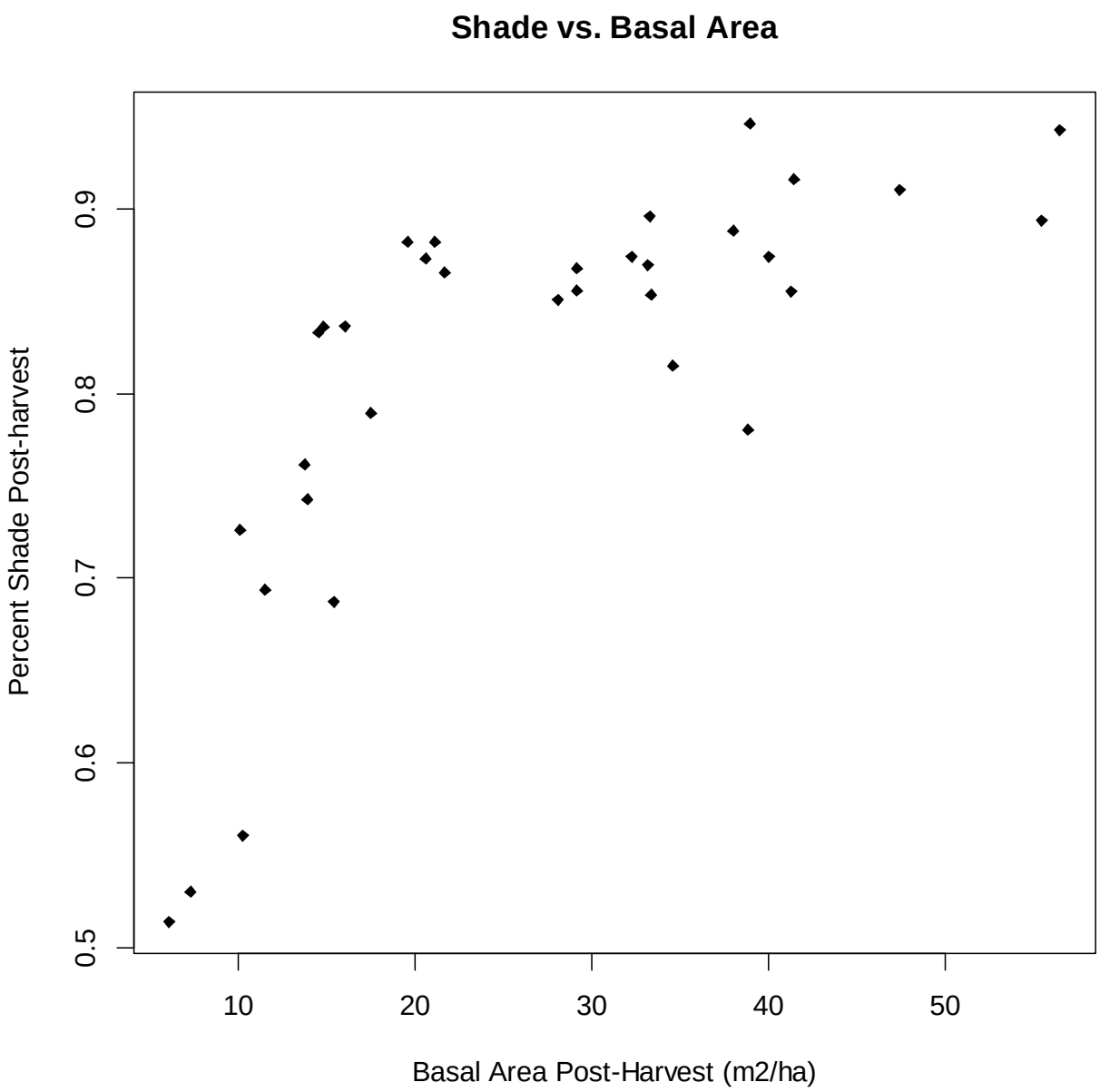
Why 100'?

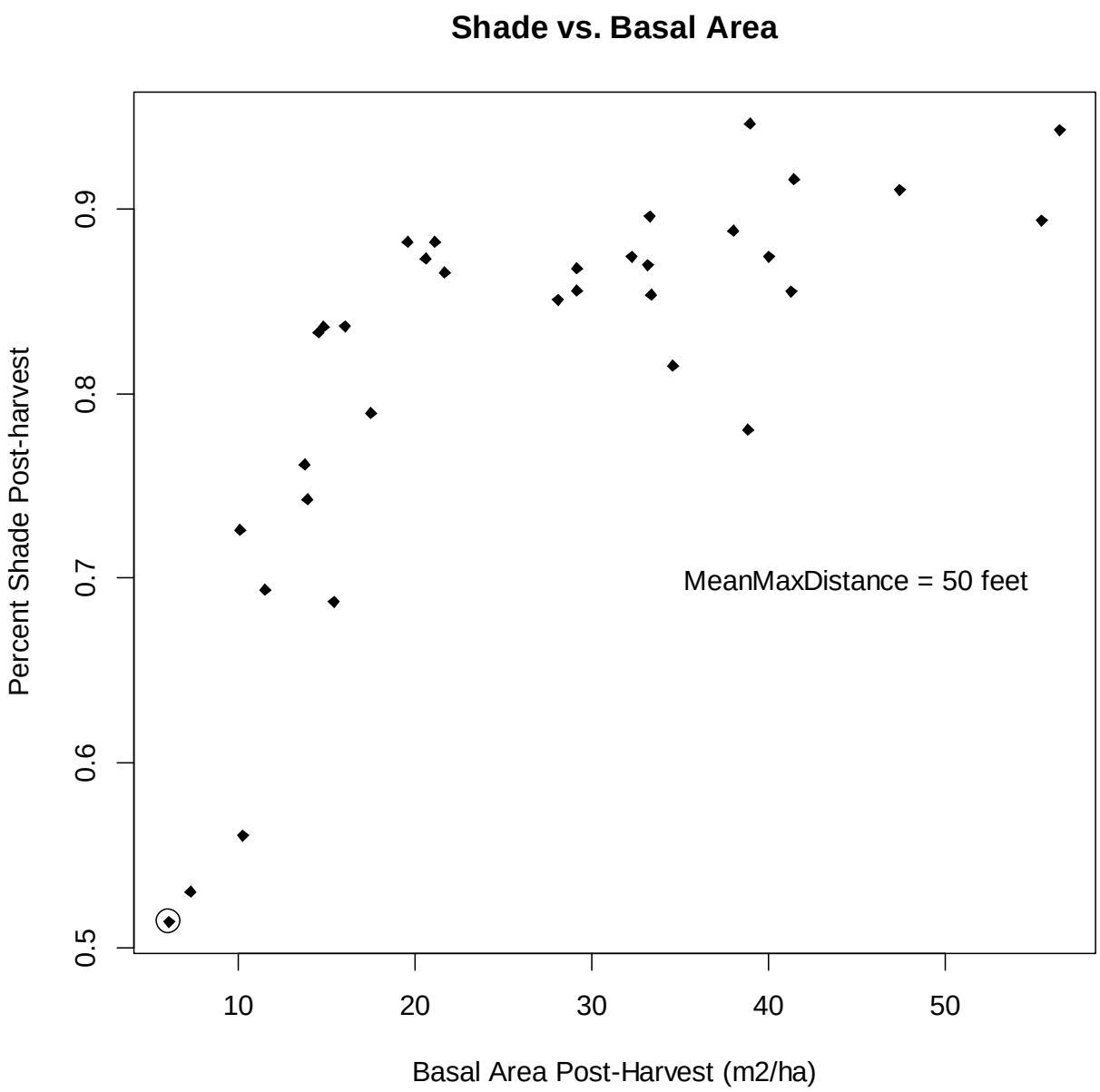
- Trees ~ 100' tall
- Most intense radiation between 10:00 & 2:00
- In summer, trees > 100' have little effect on stream shading at that time

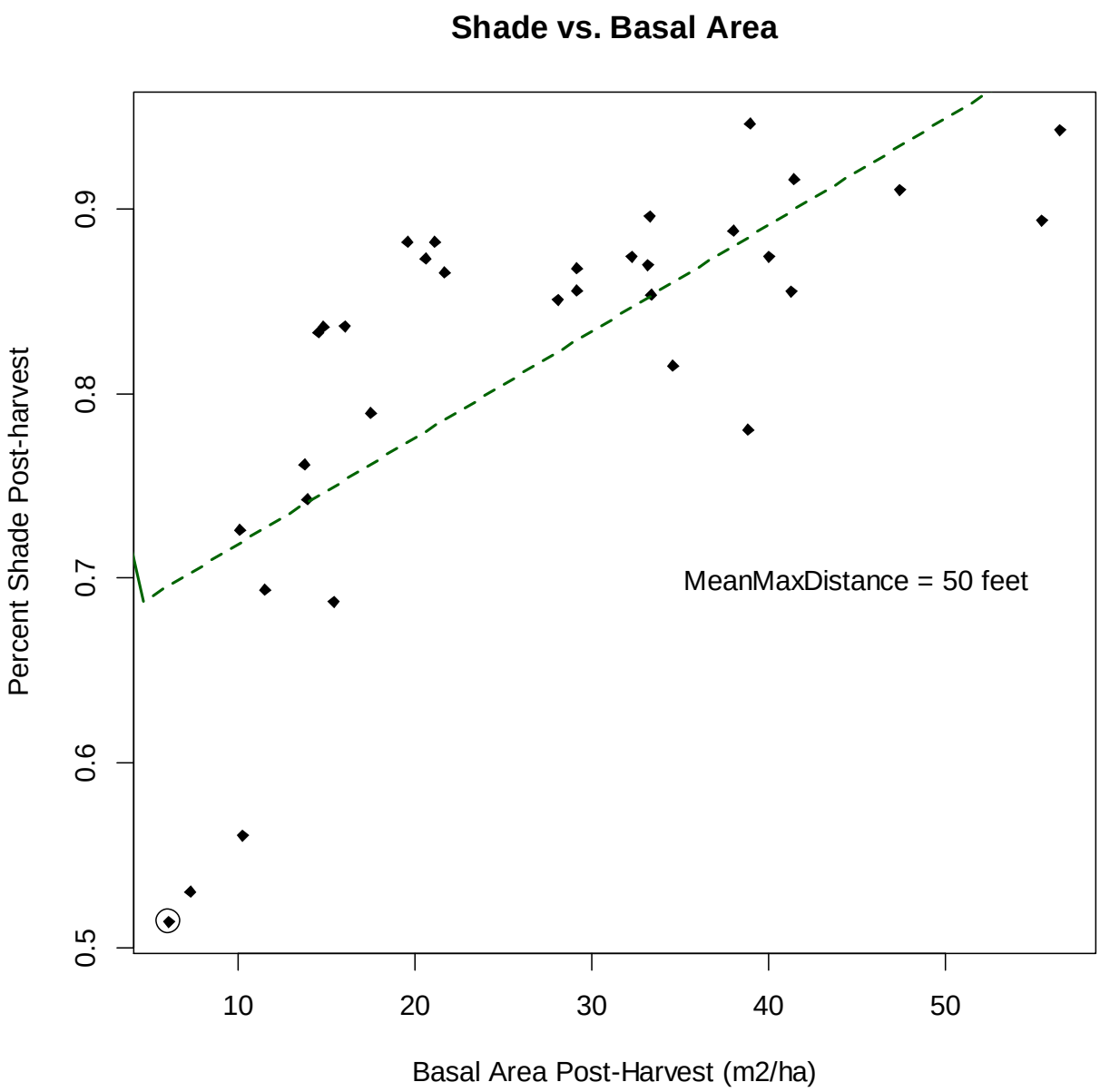


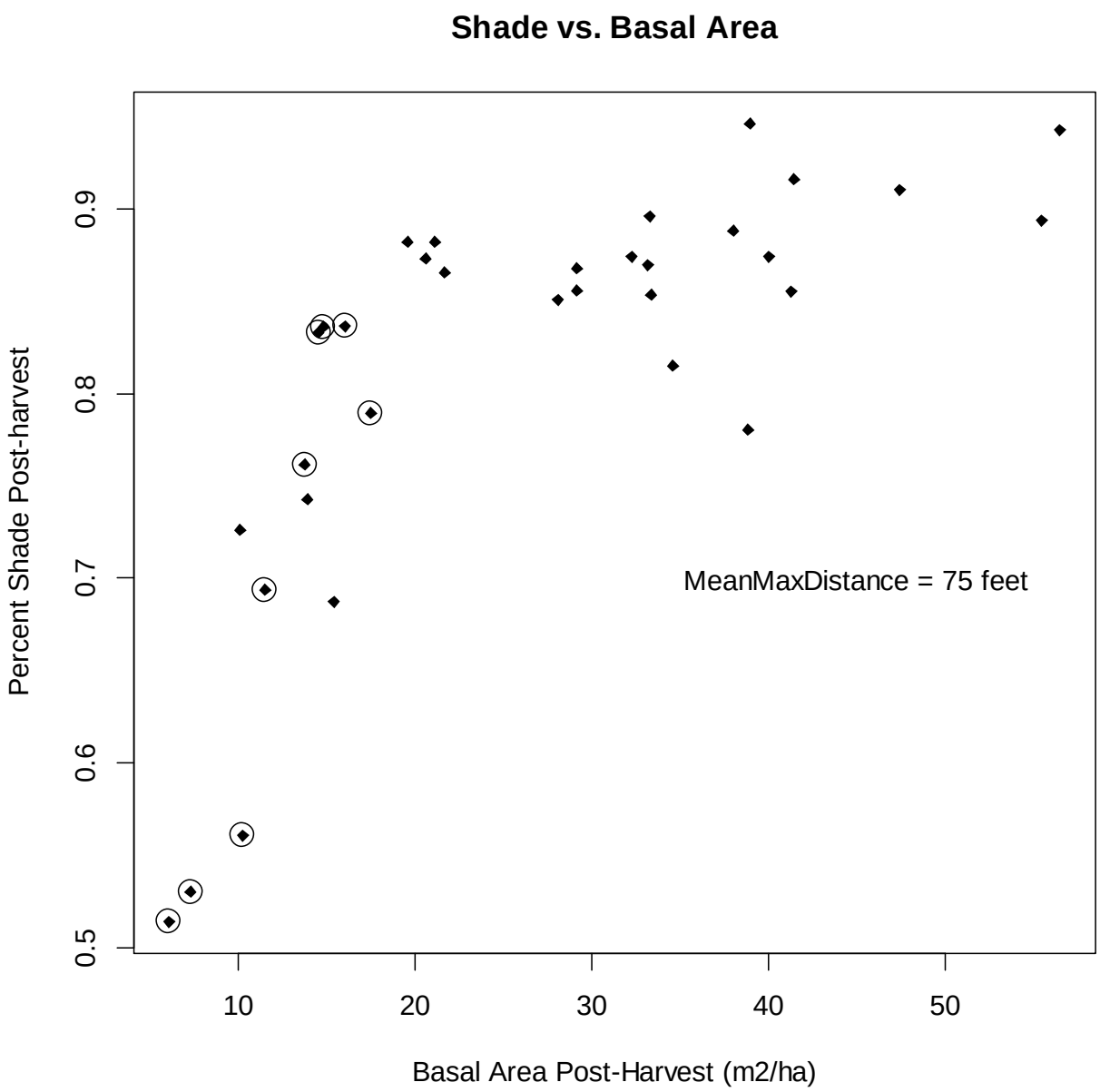
Out to 170'… how to include distance?

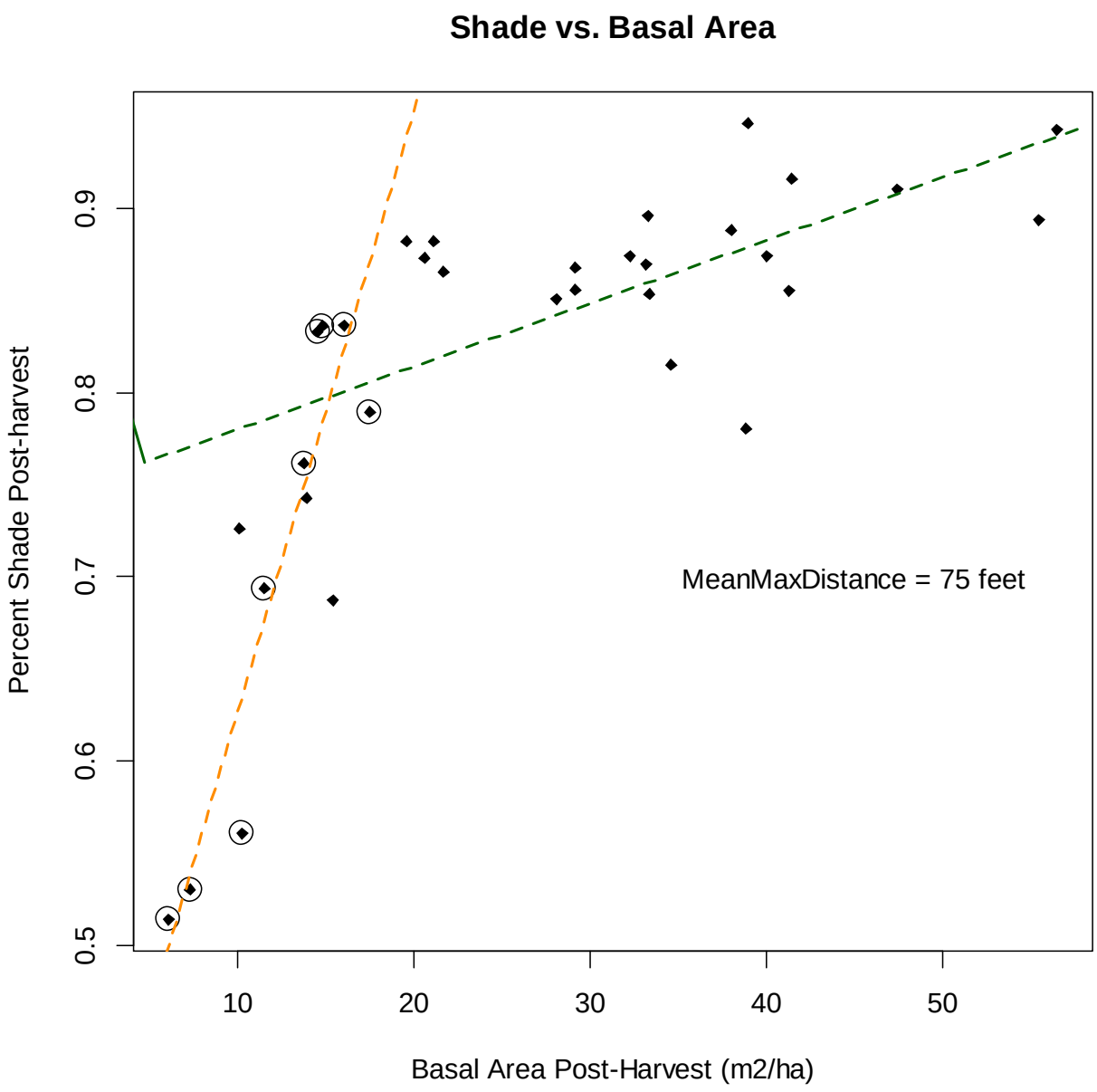
- We can include all trees out to 170'
- **MeanMaxDist**
- Distance, shade, basal area relationships

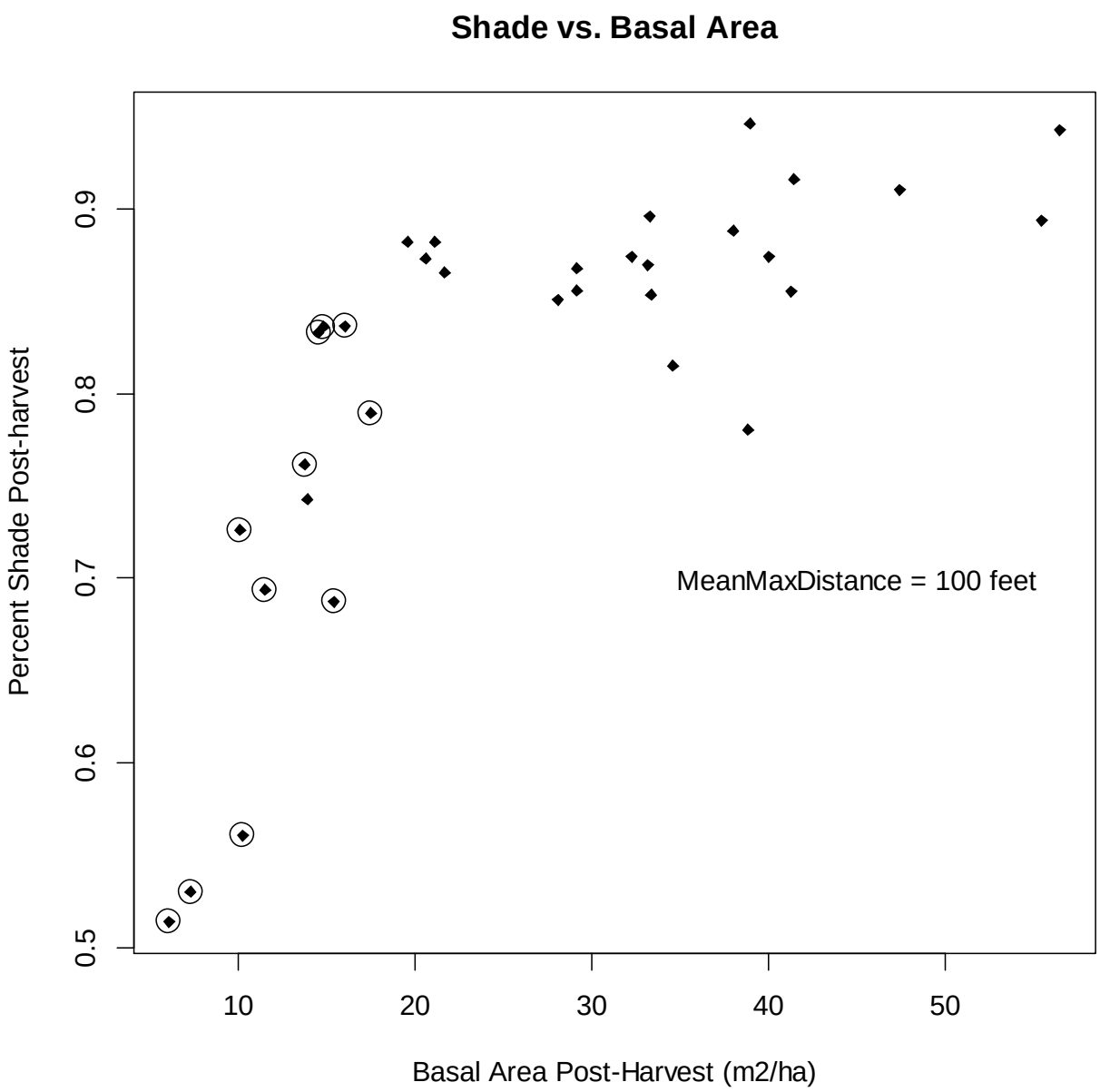

Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)

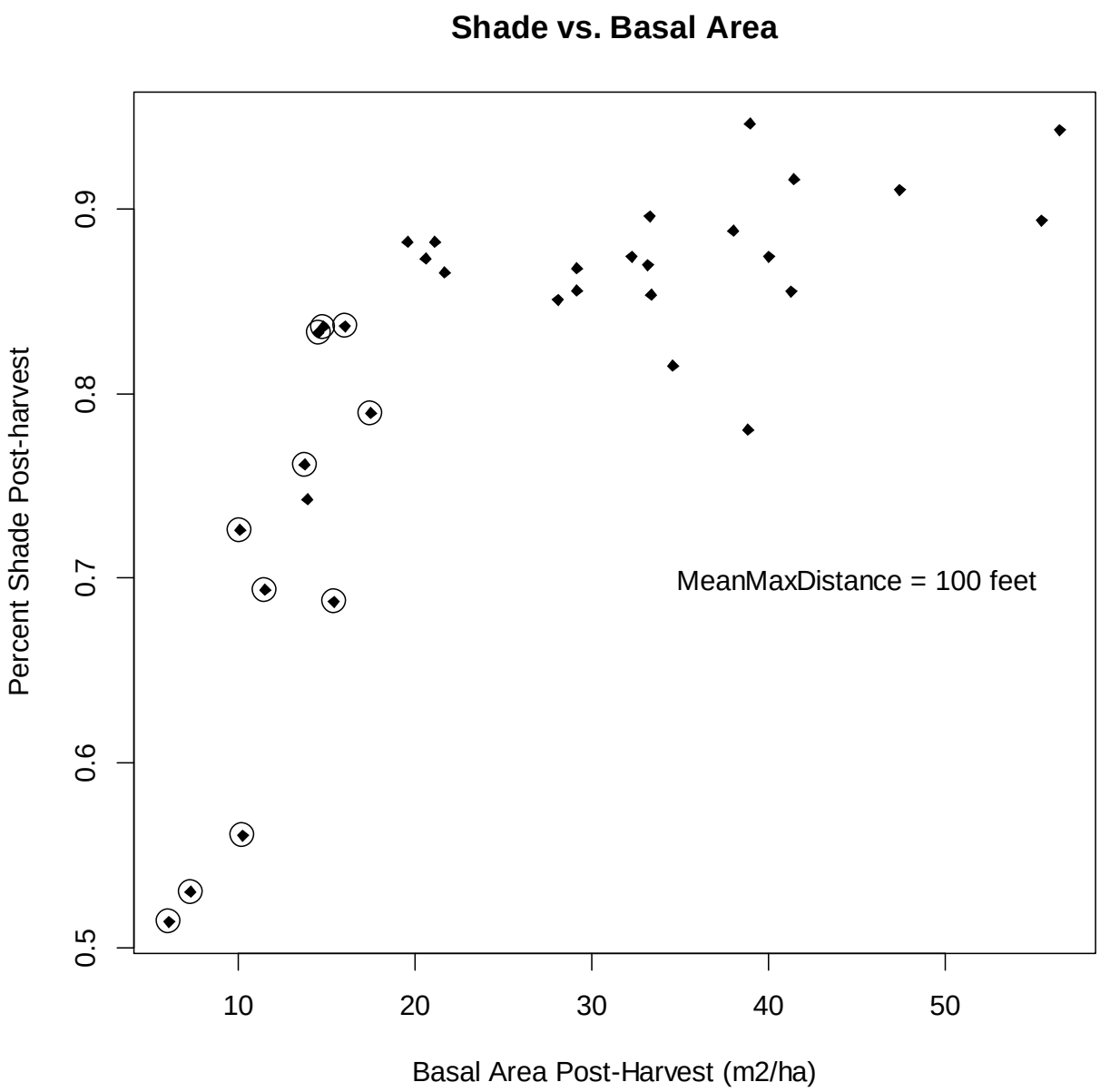

Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
MeanMaxDistance = 50 feet
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)

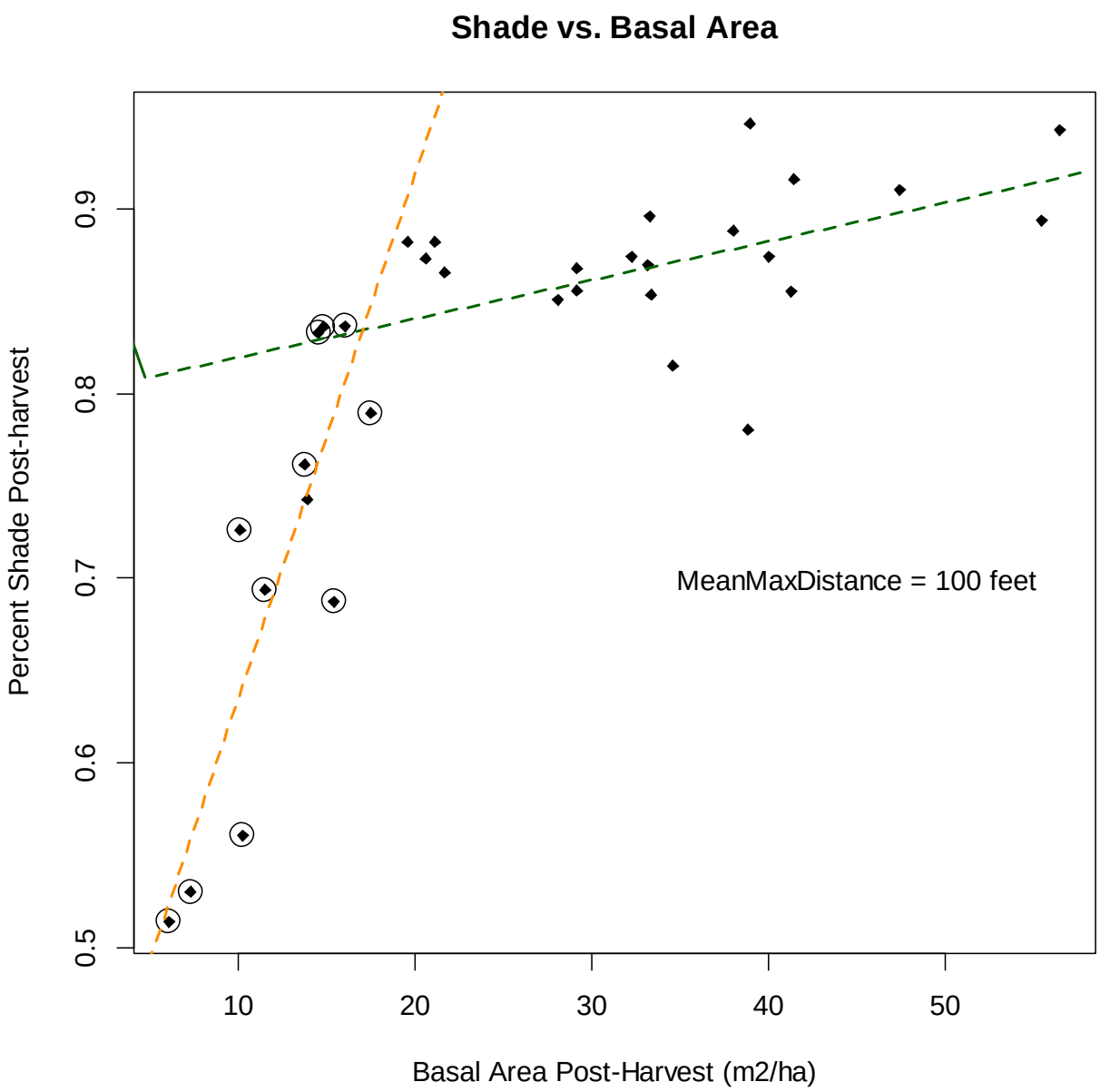

Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
MeanMaxDistance = 50 feet
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)

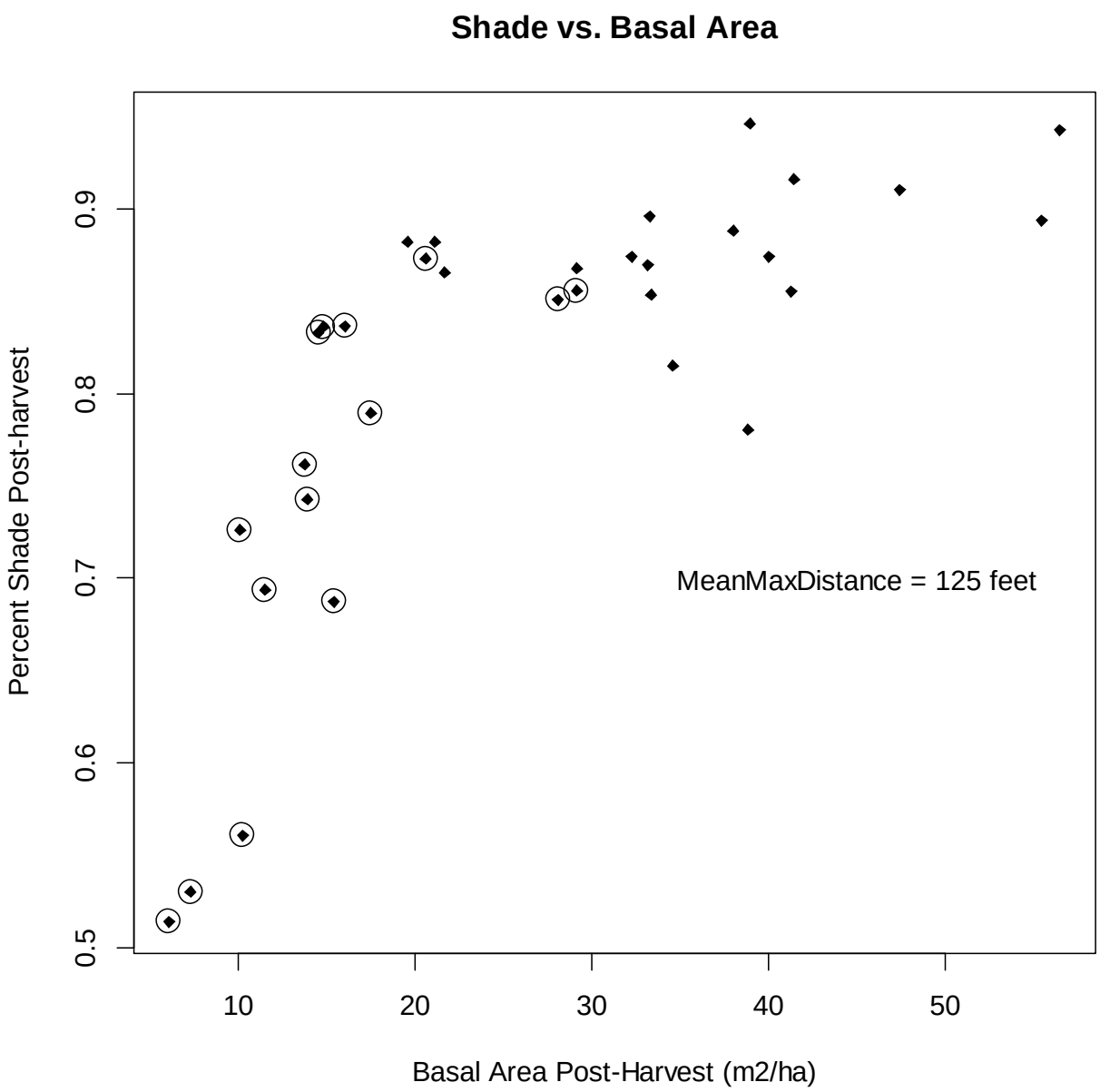

Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)
MeanMaxDistance = 75 feet

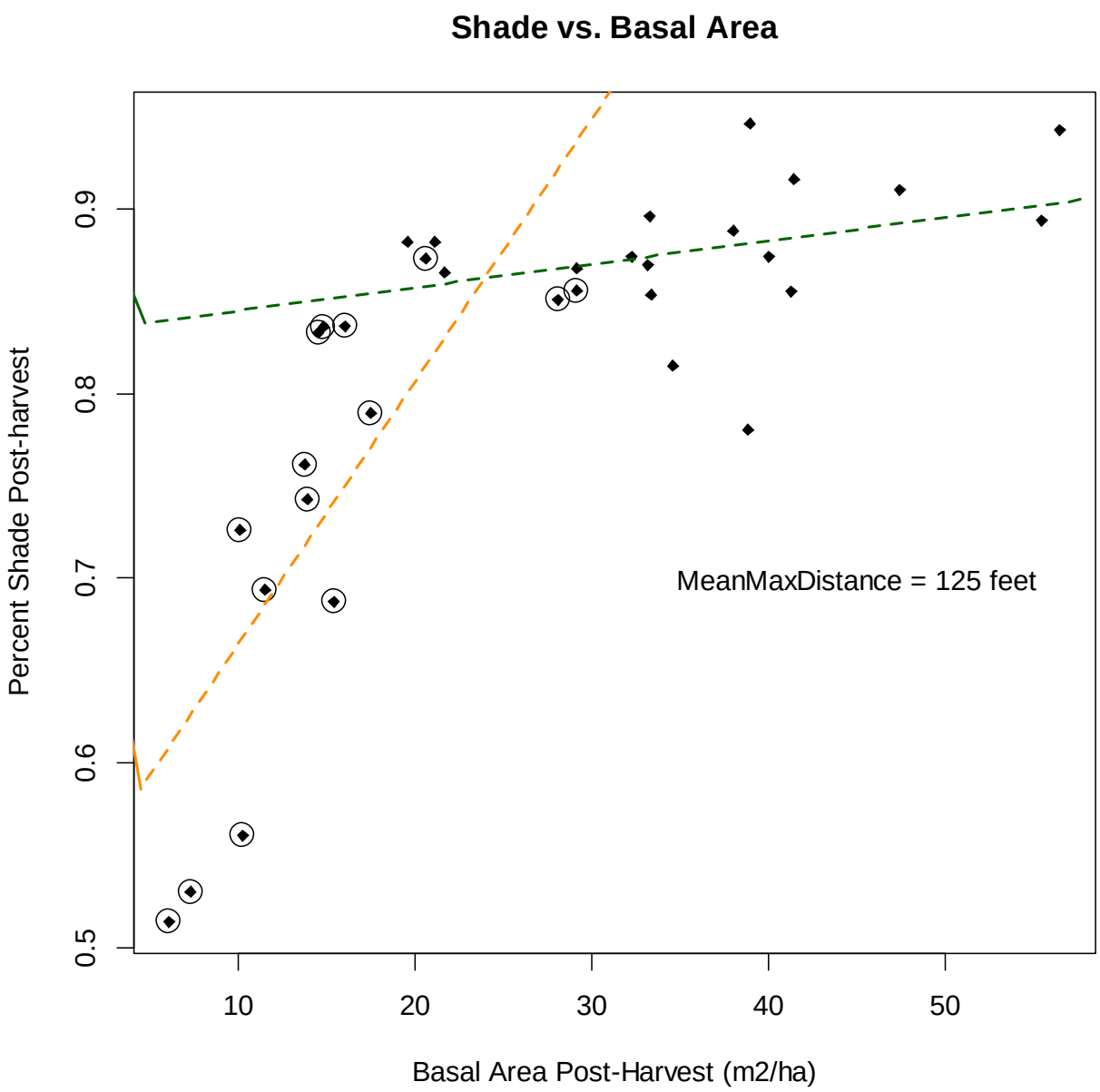

Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)
MeanMaxDistance = 75 feet


Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)
MeanMaxDistance = 100 feet


Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)
MeanMaxDistance = 100 feet


Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)
MeanMaxDistance = 100 feet


Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)
MeanMaxDistance = 125 feet


Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)
MeanMaxDistance = 125 feet

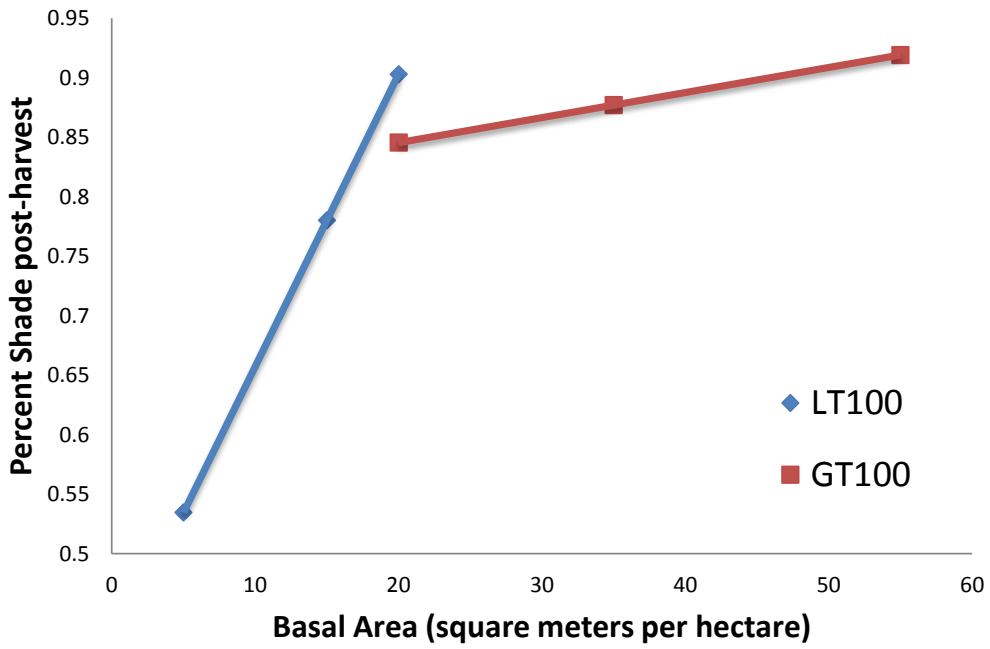
Shade v.2.0

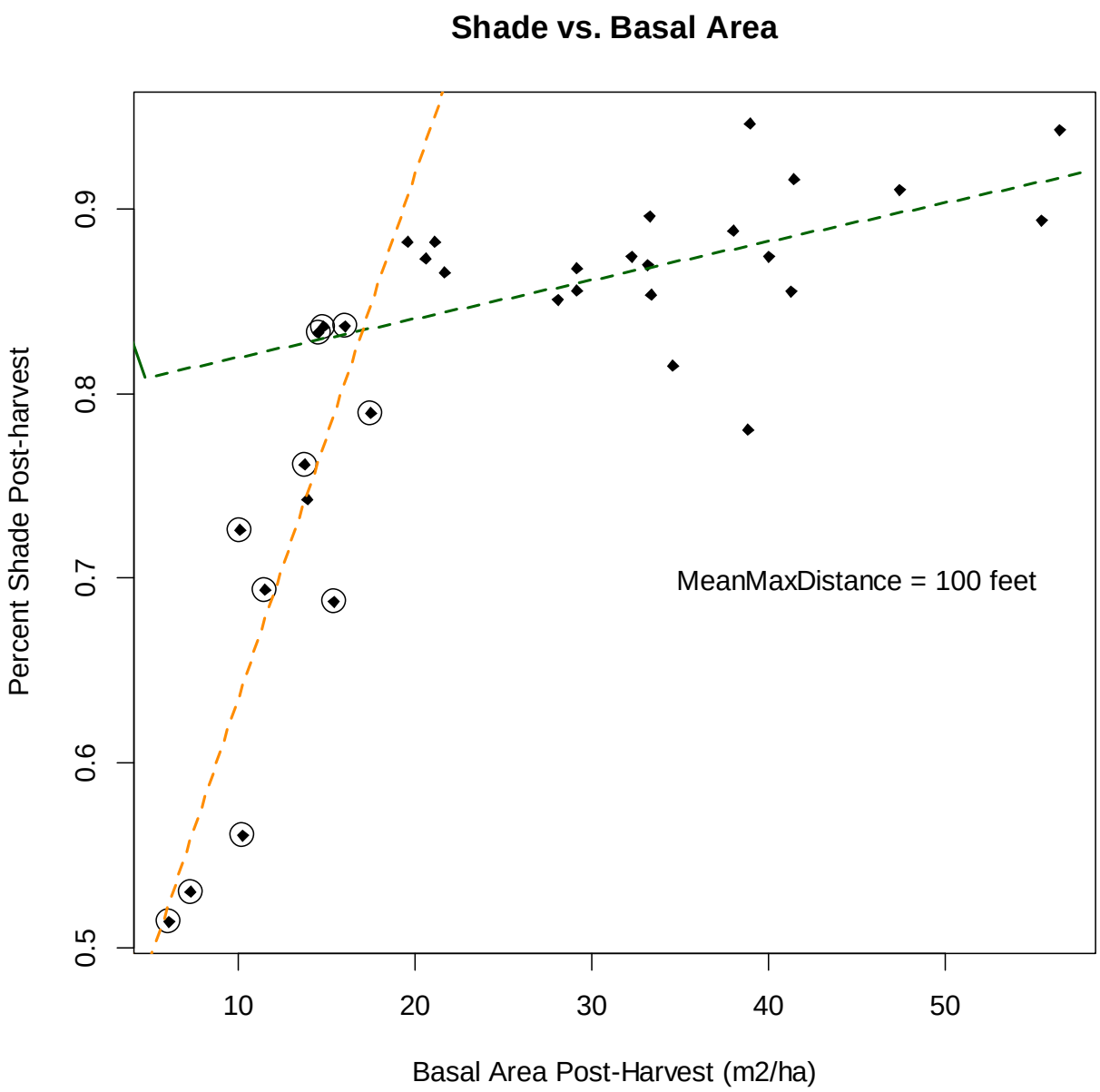
- Pre-harvest: Shade = raw shade data (not modeled)

- Post-harvest:

$$Shade_{Post} = \alpha_{Shade} + \beta_{1Shade} LT100 + \beta_{2Shade} BasalAreaPost170 + \beta_{3Shade} LT100 * Basal\ AreaPost170 + \beta_{4Shade} TreeHeightPre170$$

Shade retention by incursion distance, </> 100', mean veg plot extent




Shade vs. Basal Area
Percent Shade Post-harvest
0.5
0.6
0.7
0.8
0.9
10
20
30
40
50
Basal Area Post-Harvest (m2/ha)
MeanMaxDistance = 100 feet

Shade decisions

- Reason to limit BA examined to <100’
- Didn’t like Shade 1 (fit, too many variables, hard to explain)
- Logit of shade?

Shade 4(?)

- Within 100’ of stream
- Logit shade depends on

  % difference in basal area

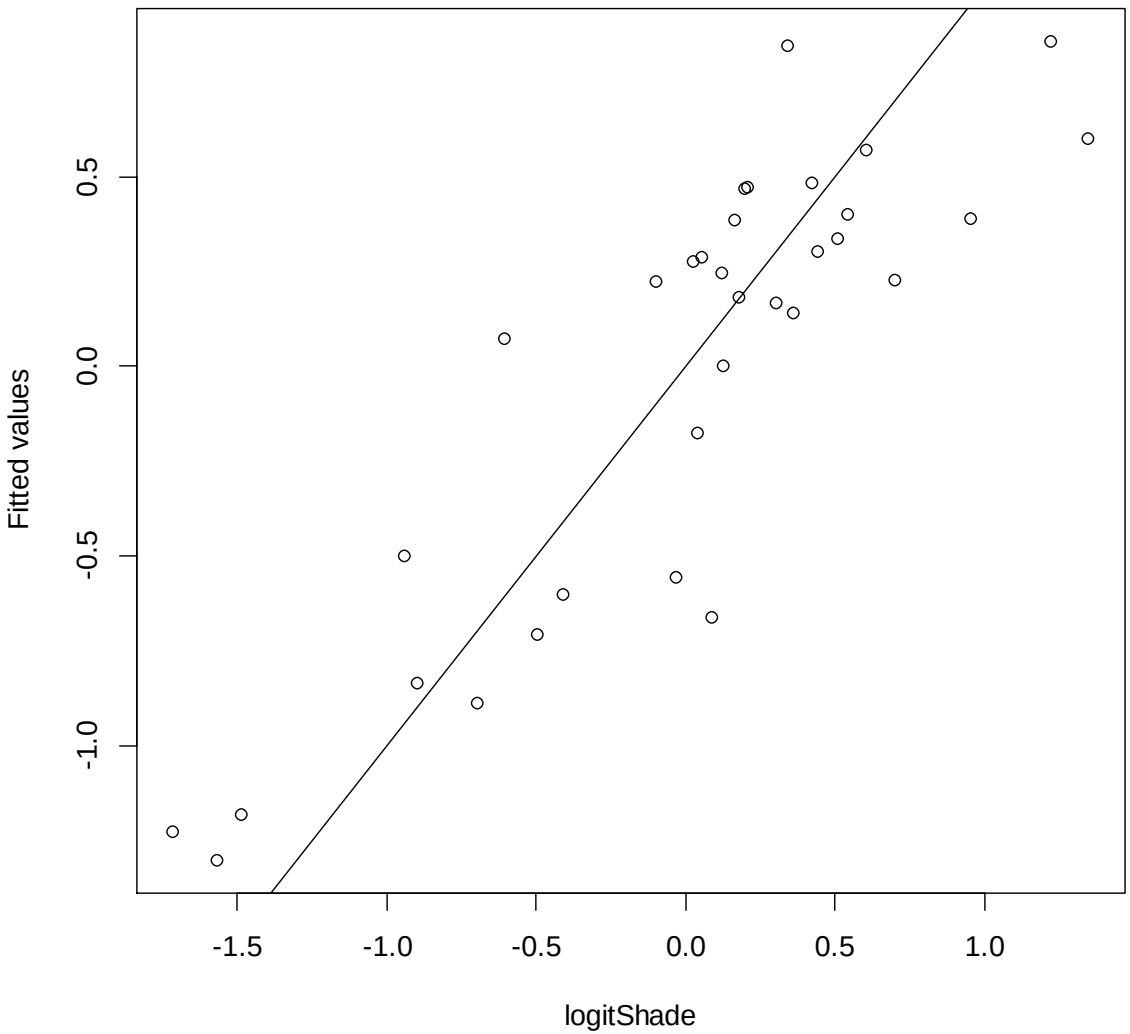
  Percent hardwood (preharvest)

  Tree height (like original model)

[4] $$Logit\ Shade_{Post} = \alpha_{Shade} + \beta_{1Shade} PctDifferenceBA_{100} + \beta_{2Shade} PctHWD_{Pre100} + \beta_{3Shade} TreeHt_{100})$$

$R^2 = 0.78$

Predicted vs. observed for Shade 4

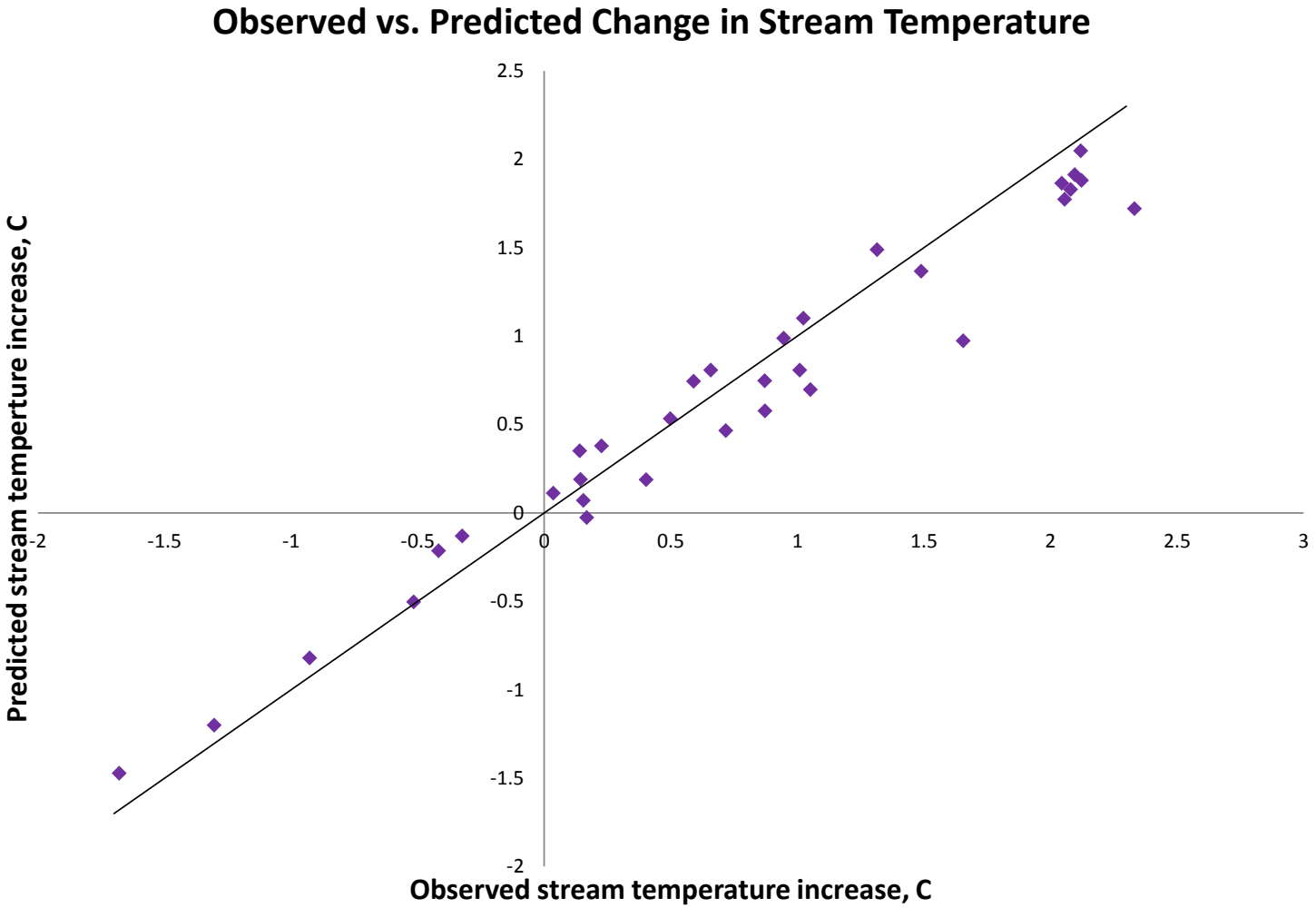


Back to the Analysis…

All estimated at once, Shade 4

$$Logit\ Shade_{Post} = \alpha_{Shade} + \beta_{1Shade} PctDifferenceBA_{100} + \beta_{2Shade} PctHWD_{Pre100} + \beta_{3Shade} TreeHt_{100})$$

$$\Delta T_{3-2ij} = \alpha_0 + \alpha_j + (\beta_1 \Delta TControl_{2-1} + \beta_i \Delta TControl_{2-1j}) + \beta_2 TreatmentReachLength + \beta_3 Shade_{Post} + \beta_4 GradientQuartile$$


Observed vs. Predicted Change in Stream Temperature
Predicted stream temperture increase, C
Observed stream temperature increase, C
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3

Prediction

$$\begin{aligned}\Delta\hat{T}_{3-2ij} = \; & \alpha_0 + \alpha_j + (\beta_1 \Delta TControl_{2-1} \\ & + \beta_i \Delta TControl_{2-1j}) \\ & + \beta_2 TreatmentReachLength \\ & + \beta_3 (inverse\ logit\ of: \alpha_{Shade} \\ & + \beta_{1Shade} \mathbf{PctDifferenceBA} \\ & + \beta_{2Shade} PctHwd_{100} \\ & + \beta_{3Shade} TreeHeightPre_{100}) \\ & + \beta_4 GradientQuartile\end{aligned}$$

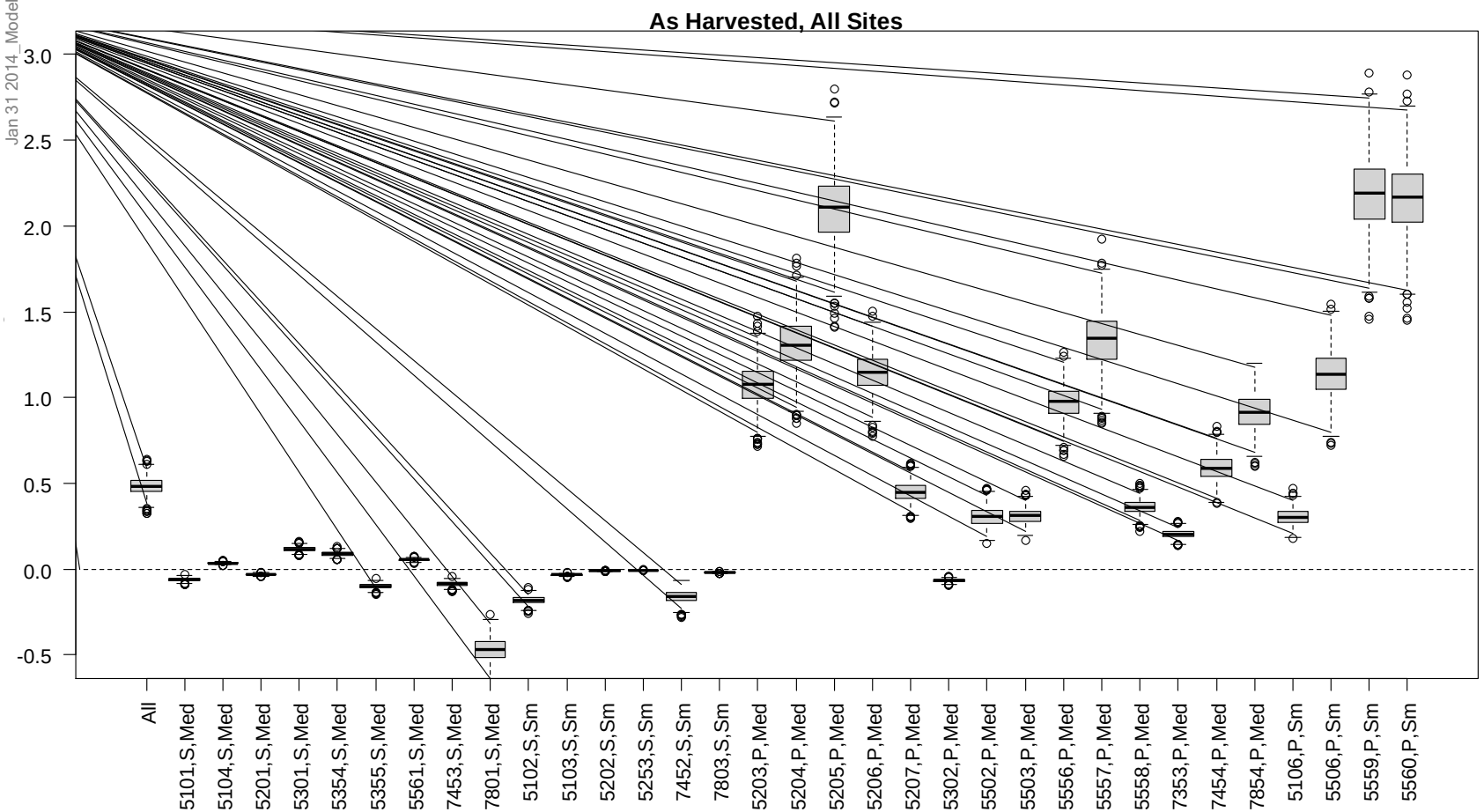
For first year post-harvest, **BA_Reduction** =

1) Simulated change 2) Zero change

→ Subtract these values. Get estimates.

As Harvested – Predicted (Shade 4)

State Mean = -0.05 Private = 0.94



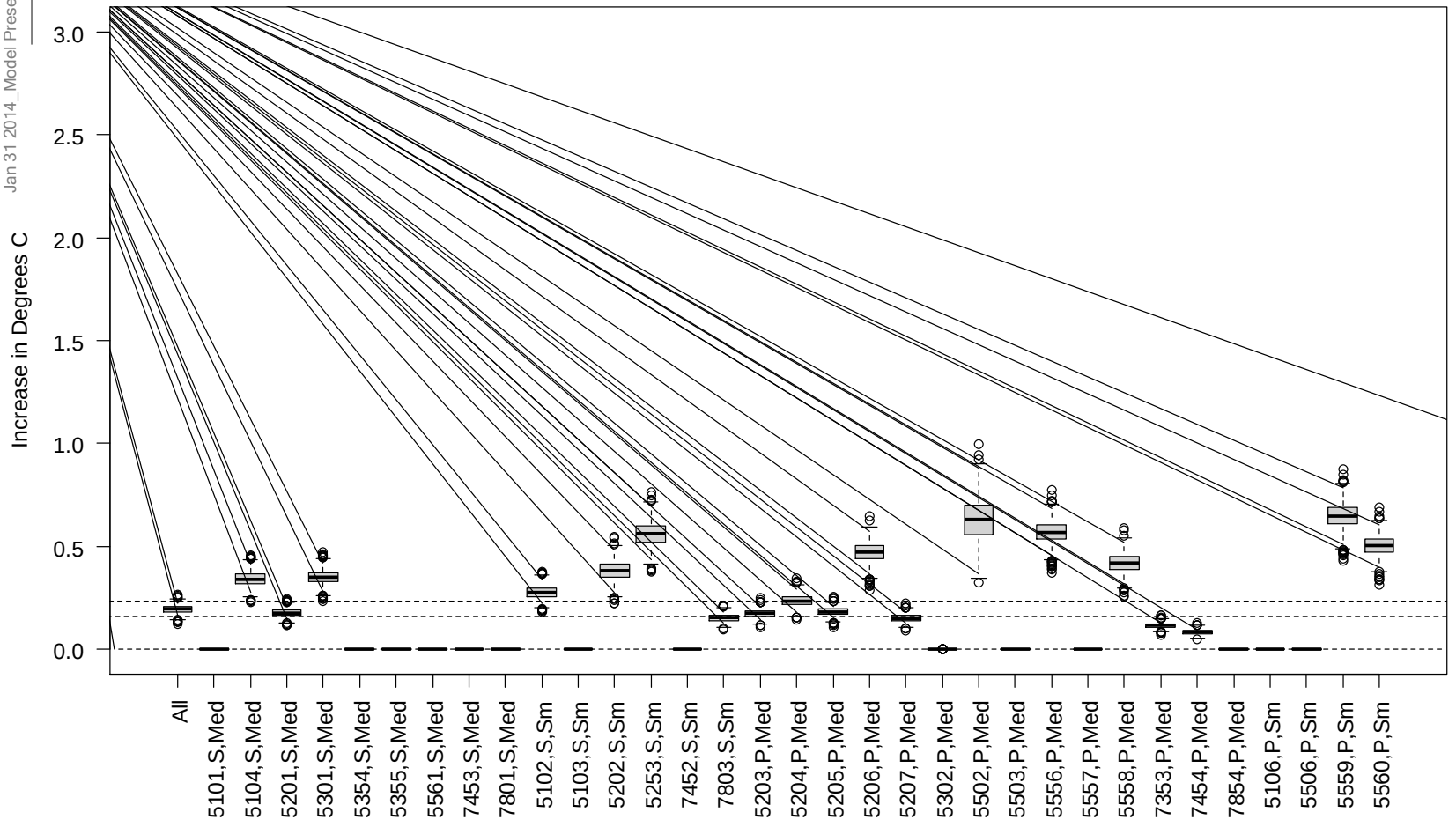
Harvest simulation

- Simulate harvests by specifying:
  - hardwood and conifer BA retention
  - Distance of no-cut buffers
  - Retention by diameter class
  - Number of retention trees
  - SDI
  - Height (harder)

- Can report other metrics

State Forests – Simulated

Quantiles: 50% = **0.19** 95% = **0.22**



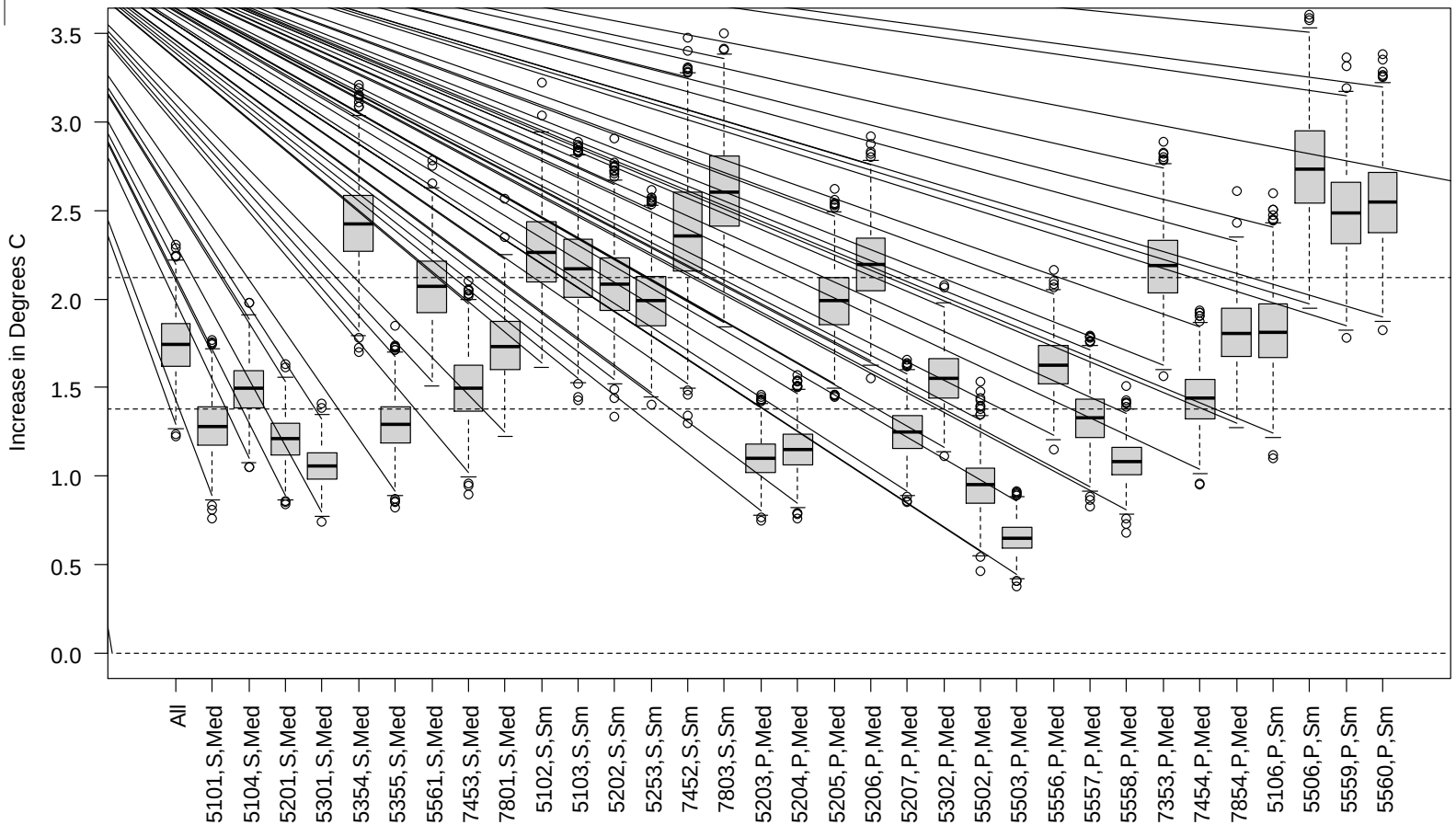
Where are we??

- What we have:
  - Models
  - Ability to manipulate stand data
  - Method for getting predictions
  - Method for stand manipulation → model inputs
  - Slope data
  - Some model validation complete
    - Parameter check, pred vs. obs, some prior checks
  - Review from Dr. Lisa Madsen, Statistician, OSU

What holes need filled?

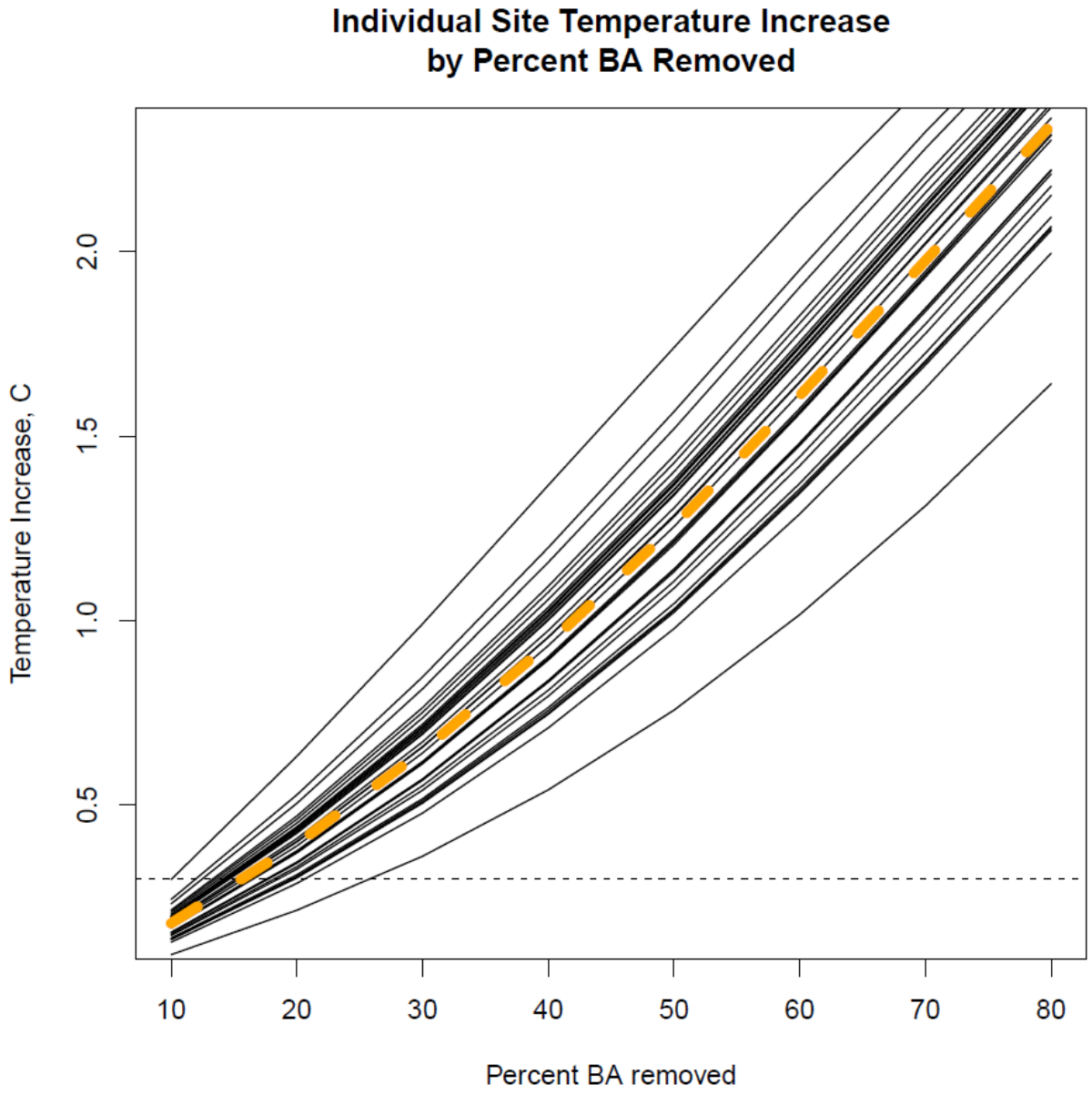
- Model leave-one-out cross-validation
- Priors tested in main model
- 40 day vs. 7DMM
- How did harvests compare??
- Specific prescriptions
- Write up methods

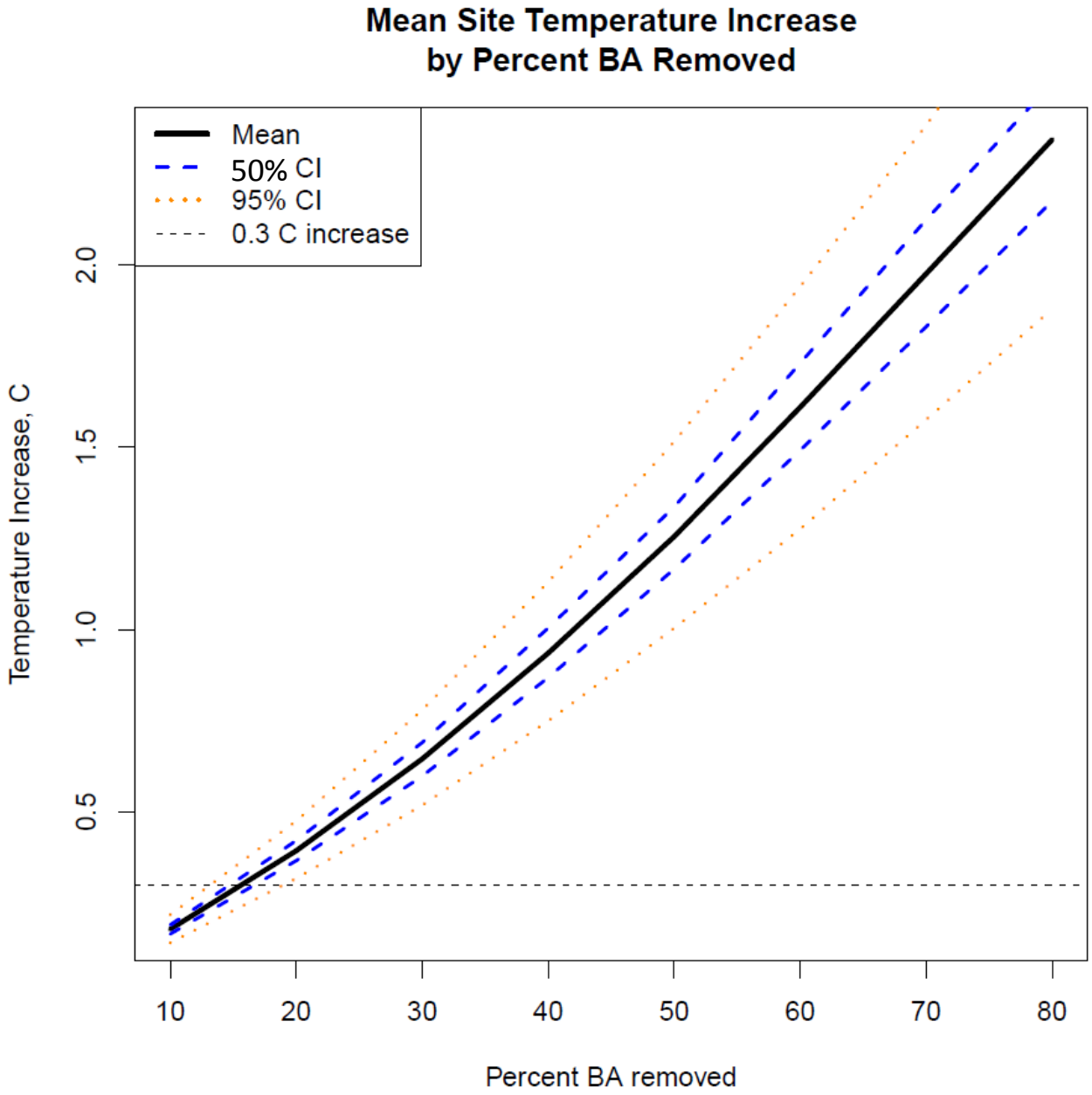
FPA Harvest - Simulated



What if we looked at % change?

- PctDifferenceBA:
  - Reduce all sites by 10, 20, 30… 80 %
  - Look at across-the-sites response

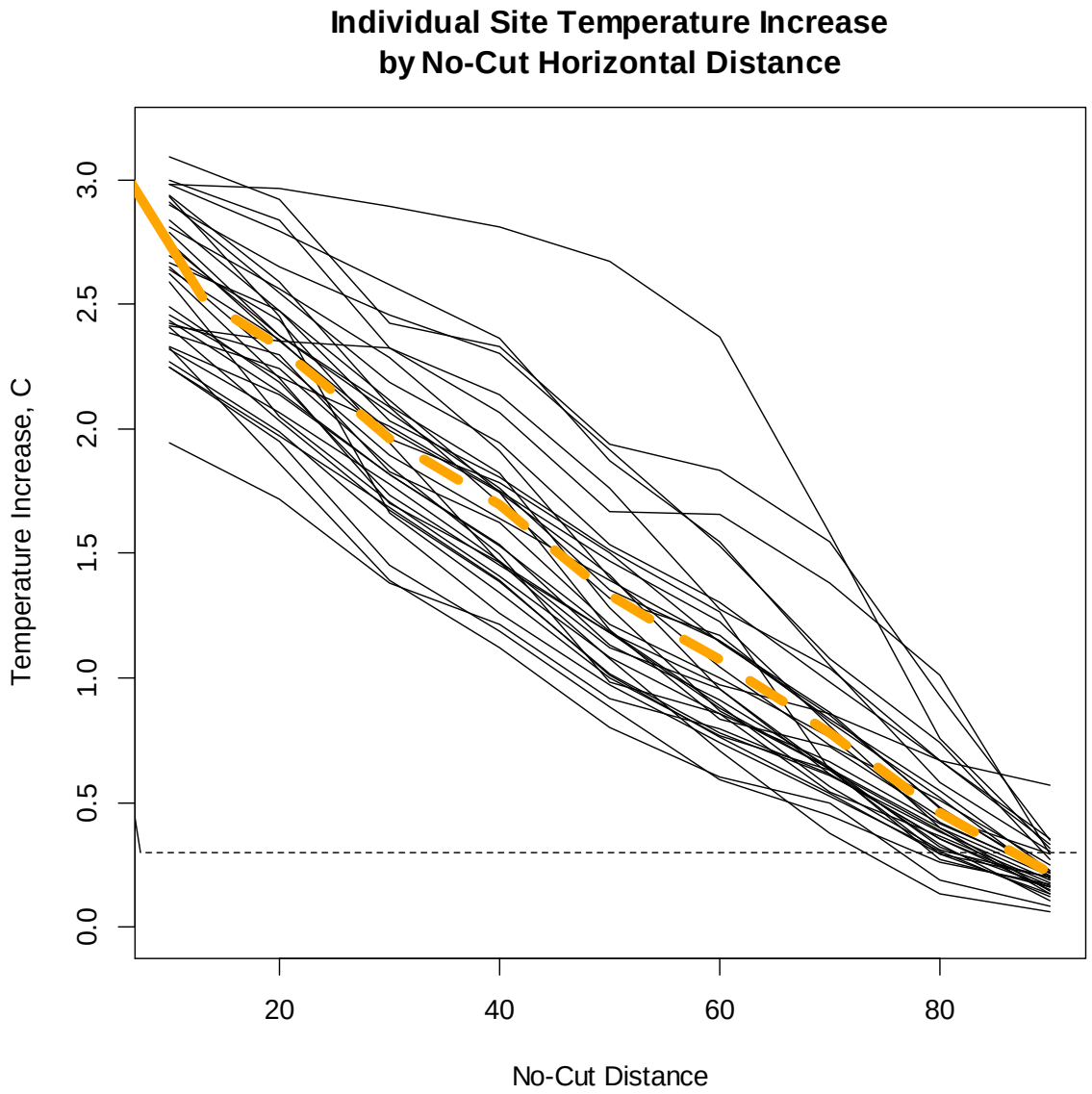

Individual Site Temperature Increase
by Percent BA Removed
Temperature Increase, C
0.5
1.0
1.5
2.0
10
20
30
40
50
60
70
80
Percent BA removed

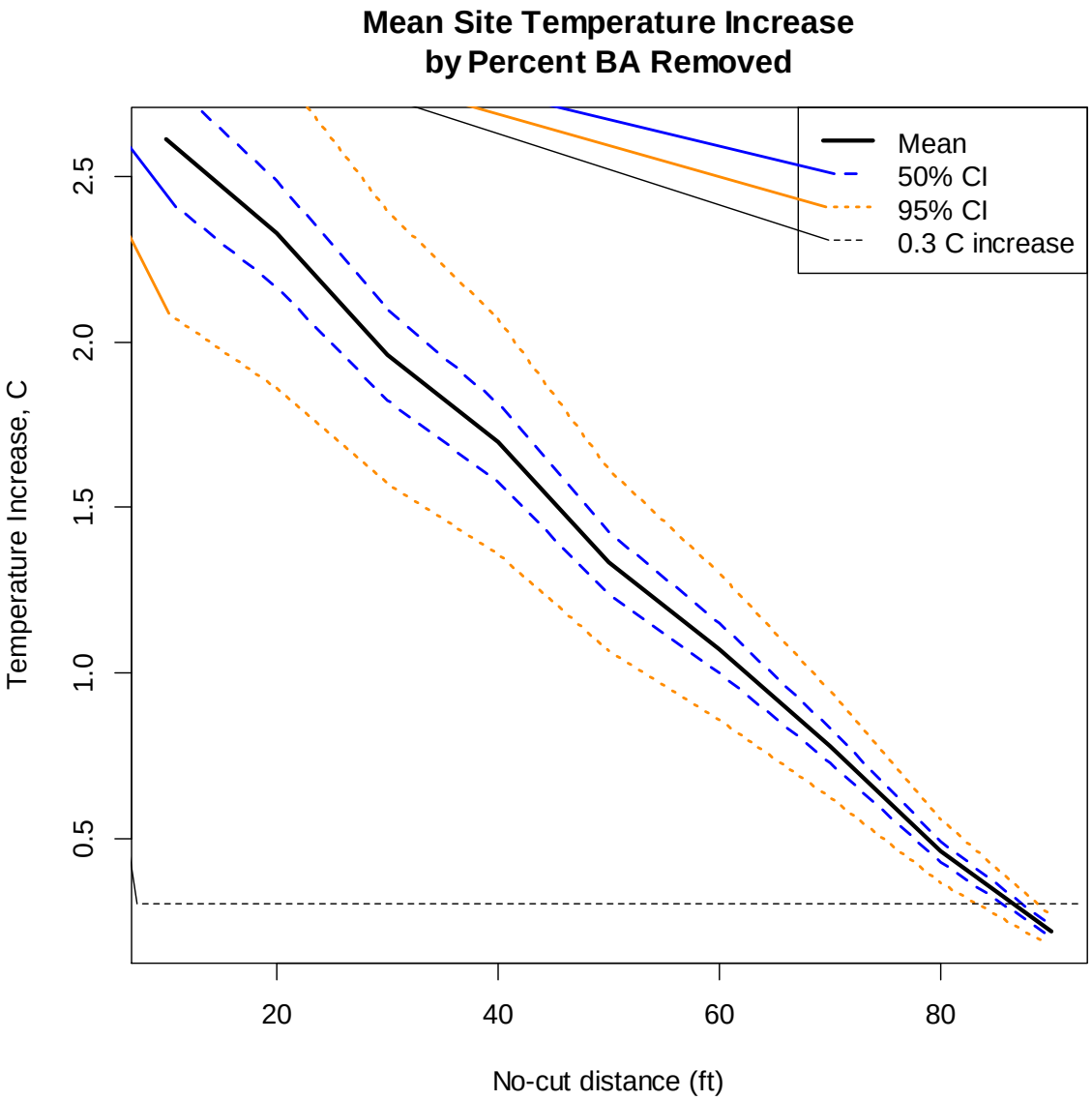

Mean Site Temperature Increase
by Percent BA Removed
Mean
50% CI
95% CI
0.3 C increase
Temperature Increase, C
0.5
1.0
1.5
2.0
10
20
30
40
50
60
70
80
Percent BA removed

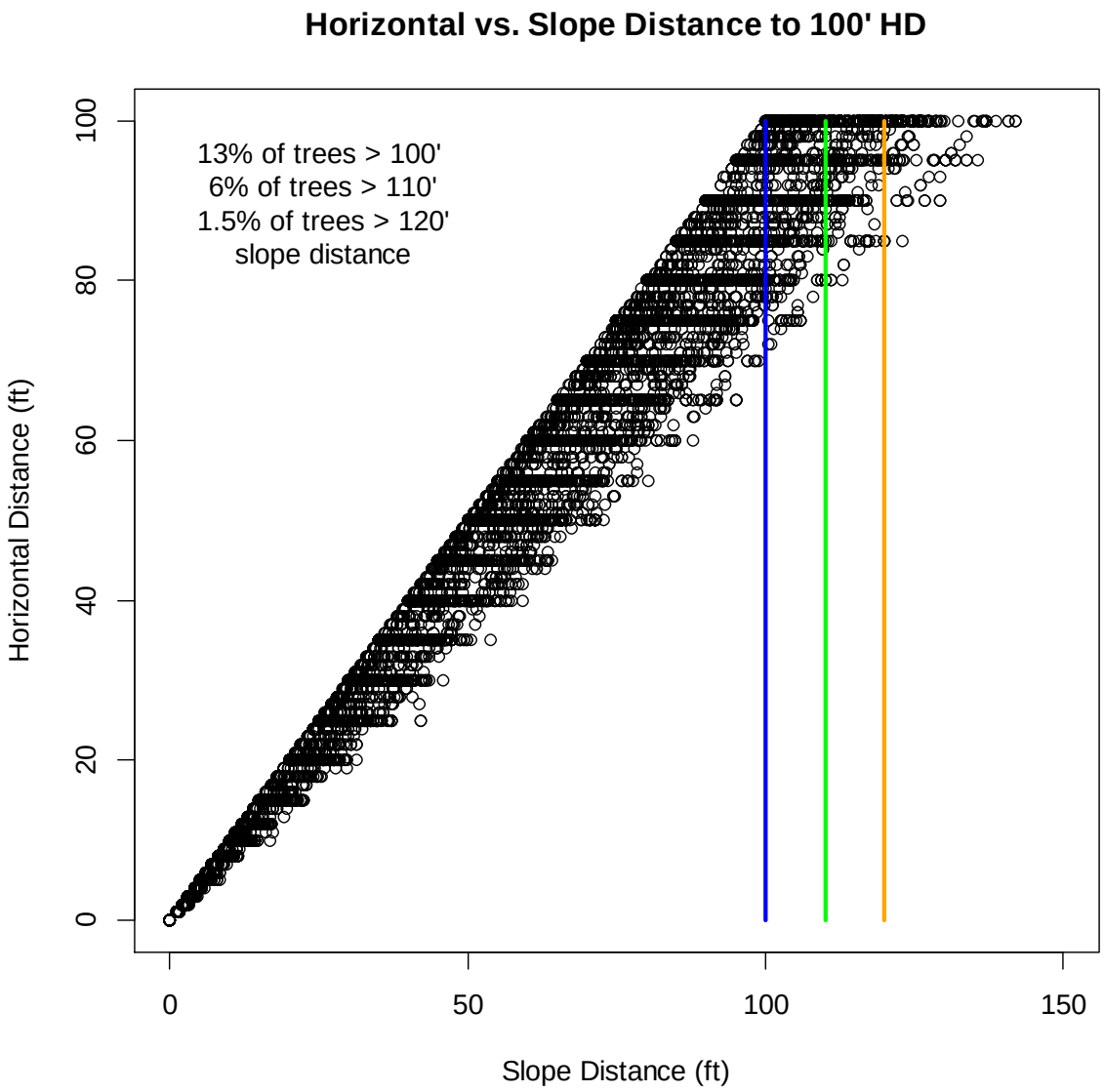
What if by distance from stream?

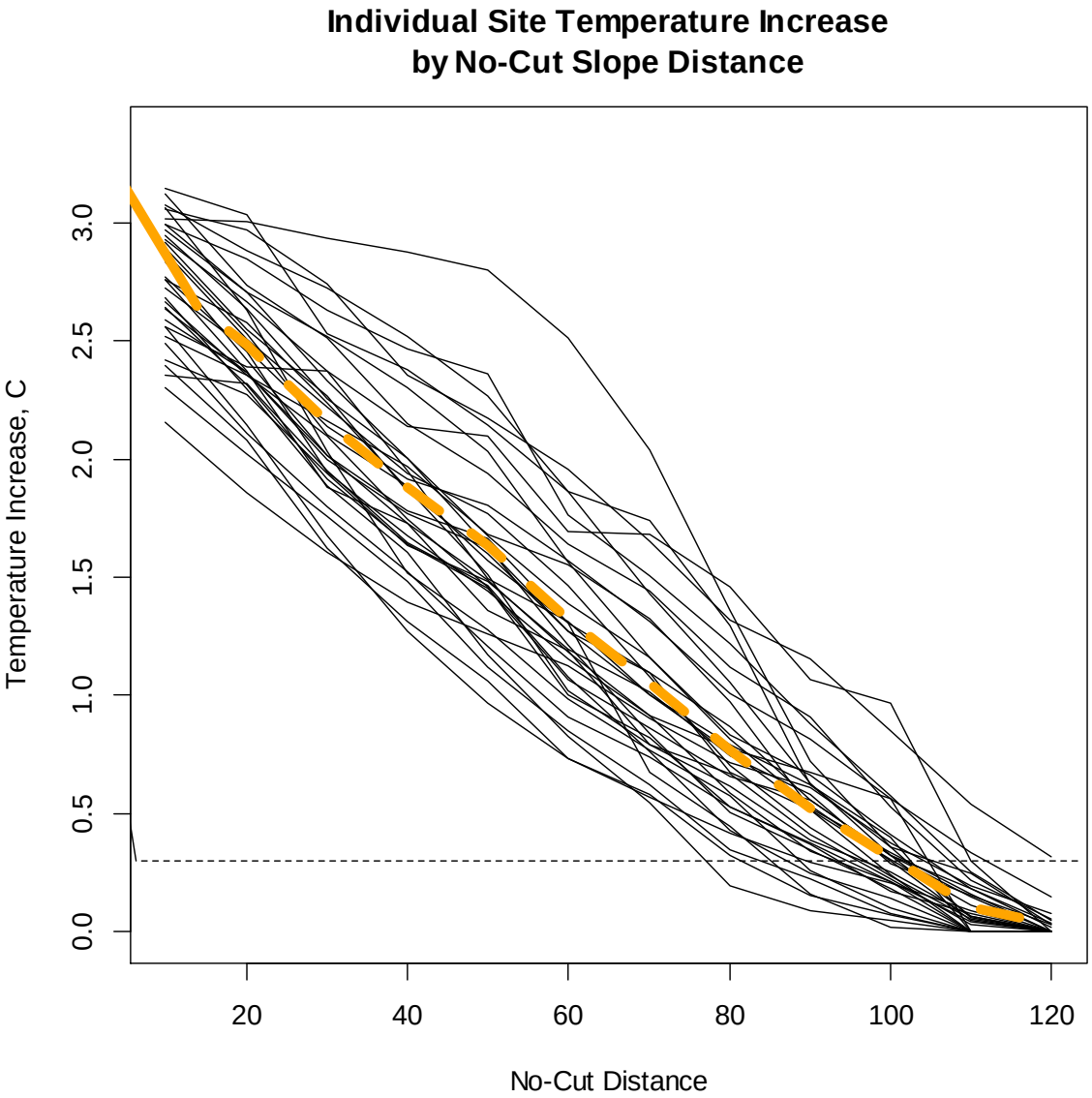
- Remove all trees beyond 10', 20'….
- Model uses horizontal distance
  - Difference between horizontal & slope

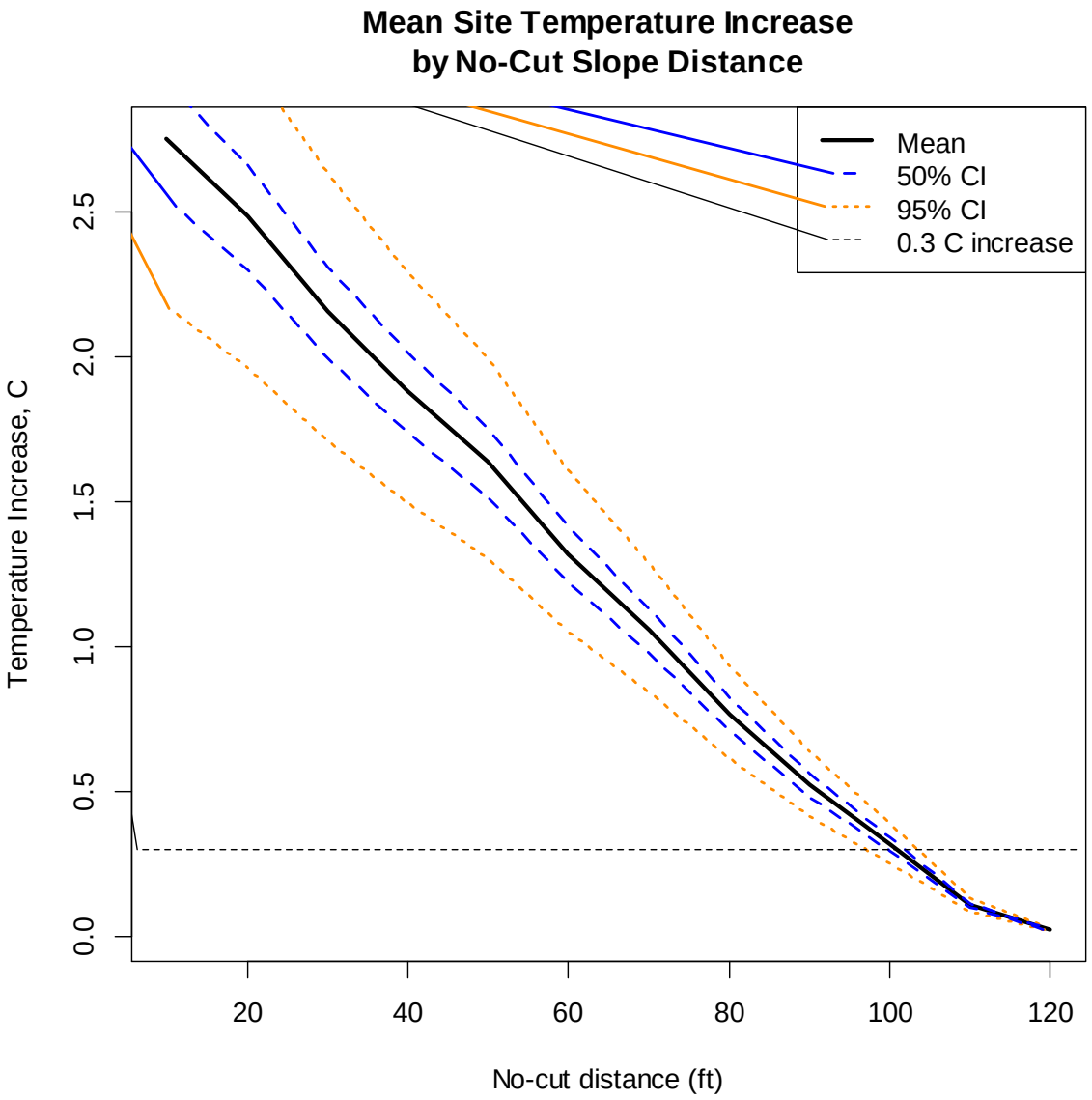
- Look at removing trees by
  1) Horizontal distance (to 100')
  2) Slope distance (to 120')


Individual Site Temperature Increase
by No-Cut Horizontal Distance
Temperature Increase, C
0.0
0.5
1.0
1.5
2.0
2.5
3.0
20
40
60
80
No-Cut Distance


Mean Site Temperature Increase
by Percent BA Removed
Mean
50% CI
95% CI
0.3 C increase
Temperature Increase, C
0.5
1.0
1.5
2.0
2.5
20
40
60
80
No-cut distance (ft)


Horizontal vs. Slope Distance to 100' HD
13% of trees > 100'
6% of trees > 110'
1.5% of trees > 120'
slope distance
Horizontal Distance (ft)
Slope Distance (ft)
0
20
40
60
80
100
0
50
100
150


Individual Site Temperature Increase
by No-Cut Slope Distance
Temperature Increase, C
0.0
0.5
1.0
1.5
2.0
2.5
3.0
20
40
60
80
100
120
No-Cut Distance


Mean Site Temperature Increase
by No-Cut Slope Distance
Mean
50% CI
95% CI
0.3 C increase
Temperature Increase, C
0.0
0.5
1.0
1.5
2.0
2.5
20
40
60
80
100
120
No-cut distance (ft)

Conceptual Figure

(Not based on actual simulations)